APPENDIX I

GLOSSARY

ABSOLUTE ADDRESS.—An address that is permanently assigned by the machine designer to a storage location. Synonymous with machine address, specific address.

ABSOLUTE CODING.—Coding that uses machine instructions with absolute addresses.

ABSOLUTE ERROR.—(1) The amount of error expressed in the same units as the quantity containing the error. (2) Loosely, the absolute value of the error, i.e., the magnitude of the error without regard to its algebraic sign.

ABSOLUTE INSTRUCTION.—A machine instruction in its final executable form.

ACCEPTOR.—An impurity that can make a semiconductor P-type by accepting valence electrons, thereby leaving "holes" in the valence band. The holes act as carriers of positive charge.

ACCESS ARM.—A part of a disc storage unit that is used to hold one or more reading and writing heads.

ACCESS TIME.—(1) The time interval between the instant at which data are called for from a storage device and the instant delivery begins. (2) The time interval between the instant at which data are requested to be stored and the instant at which storage is started.

ACCUMULATOR.—A register in which the result of an arithmetic or logic operation is formed.

ACCURACY.—The degree of freedom from error, that is the degree of conformity to truth or to a rule.

ACOUSTIC DELAY LINE.—A delay line whose operation is based on the time of propagation of sound waves in a given medium. Synonymous with sonic delay line.

ACOUSTIC MEMORY.—Same as acoustic storage.

ACOUSTIC STORAGE.—A storage device consisting of acoustic delay lines.

ADAPTER.—A device used to effect operative capability between different parts of one or more systems or subsystems.

ADDER.—A device whose output is a representation of the sum of the quantities represented by its inputs.

ADDRESS.—(1) An identification, as represented by a name, label, or number, for a register, location in storage, or any other data source or destination such as the location of a station in a communication network. (2) Loosely, any part of an instruction that specifies the location of an operand for the instruction.

ADDRESSING MODES.—An address is a coded instruction designating the location of data or program segments in storage. The address may refer to storage in registers or memories or both. The address code itself may be stored so that a location may contain the address of data rather than the data itself. This form of addressing is common in microprocessors. Addressing modes vary considerably because of efforts to reduce program execution time.

ADDRESS PART.—A part of an instruction word that specifies the address of an operand, instruction, or result.

ADDRESS REGISTER.—A register in which an address is stored.

ADP.—Automatic data processing.

AGONIC.—An imaginary line of the earth's surface passing through points where the magnetic declination is 0°; that is, points where the compass points to true north.

ALGOL.—(ALGOrithmic Language) A language primarily used to express computer programs by algorithms.

ALGORITHM.—A prescribed set of well-defined rules or processes for the solution of a problem in a finite number of steps, e.g., a full statement of an arithmetic procedure for evaluating sin x to a stated precision.

ALGORITHMIC LANGUAGE.—A language designed for expressing algorithms.

ALIGN.—To adjust the tuned circuits of a receiver or transmitter for maximum signal response.

ALLOYED JUNCTION.—A PN junction formed by recrystallization of a molten region of P-type material on an N-type substrate, or vice versa.

ALPHAMERIC.—Same as alphanumeric.

ALPHANUMERIC.—Pertaining to a character set that contains letters, digits, and usually other characters such as punctuation marks.

ALPHANUMERIC CHARACTER SET.—A character set that contains letters, digits, and usually other characters.

ALPHANUMERIC CODE.—A code whose code set consists of letters, digits, and associated special characters.

ALTERNATION.—One-half of a complete cycle.

ALU.—(ARITHMETIC AND LOGIC UNIT) The ALU is one of the three essential components of a computer. The other two being the registers and the control block. The ALU performs various forms of addition and subtraction; the logic mode performs such logic operations as ANDing the contents of two registers, or masking the contents of a register.

AMMETER.—An instrument for measuring the amount of electron flow in amperes.

AMPERE.—The basic unit of electrical current.

AMPERE-TURN.—The magnetizing force produced by a current of one ampere flowing through a coil of one turn.

AMPLIFICATION.—The process of increasing the strength (current, power, or voltage) of a signal.

AMPLIFICATION FACTOR (μ).—The ratio of a small change in plate voltage to a small change in grid voltage, with all other electrode voltages constant, required to produce the same small change in plate current.

AMPLIFIER.—A device used to increase the signal voltage, current, or power, generally composed of a vacuum tube and associated circuit called a stage. It may contain several stages in order to obtain a desired gain.

AMPLITUDE.—The maximum instantaneous value of an alternating voltage or current, measured in either the positive or negative direction.

AMPLITUDE DISTORTION.—The changing of a waveshape so that it is no longer proportional to its original form. Also known as harmonic distortion.

ANALOG.—Pertaining to representation by means of continuously variable physical quantities.

ANALOG COMPUTER.—(1) A computer in which analog representation of data is mainly used. (2) A computer that operates on analog data by performing physical processes on these data.

ANALYSIS.—The methodical investigation of a problem, and the separation of the problem into smaller related units for further detailed study.

ANALYST.—A person who defines problems and develops algorithms and procedures for their solution.

AND.—A logic operator having the property that if P is a statement, Q is a statement, R is a statement...., then the AND of P, Q, R..., is true if all statements are true, false if any statement if false. P AND Q is often represented by P·Q, PQ. Synonymous with logical multiply.

AND GATE.—A gate that implements the logic "AND" operator.

ANNOTATION.–An added descriptive comment or explanatory note.

ANODE.–A positive electrode; the plate of a vacuum tube.

ANTENNA.–A device used to radiate or receive radio waves.

APERTURE.–An opening in a data medium or device such as a card or magnetic core; e.g., the aperture in an aperture card combining a microfilm with a punched card or a multiple aperture core.

AQUADAG.–A graphite coating on the inside of certain cathode-ray tubes for collecting secondary electrons emitted by the screen.

ACR.–A flash caused by an electric current ionizing a gas or vapor.

ARITHMETIC SHIFT.–(1) A shift that does not affect the sign position. (2) A shift that is equivalent to the multiplication of a number by a positive or negative integral power of the radix.

ARITHMETIC UNIT.–The unit of a computing system that contains the circuits that perform arithmetic operations.

ARMATURE.–The rotating part of a d.c. electric motor or generator. The moving part of a relay or vibrator.

ARRAY.–An arrangement of elements in one or more dimensions.

ASCII.–American Standard Code for Information Interchange. The standard code, using a coded character set consisting of 7 bit coded characters (8 bits with parity), used for information interchange among data processing systems, communication systems, and associated equipment.

ASSEMBLE.–To prepare a machine language program from a symbolic language program by substituting absolute operation codes for symbolic operation codes and absolute or relocatable addresses for symbolic addresses.

ASSEMBLER.–A computer program v operates on symbolic input data to prc from such data machine instructions by car out such functions as: translation of sym operation codes into computer oper instructions; assigning locations in storag successive instructions; or computatior absolute addresses from symbolic addresse assembler generally translates input sym codes into machine instructions item for and produces as output the same numb instructions or constants which were defin the input symbolic codes. Synonymous (assembly routine); (assembly program) related to (compiler).

ASSEMBLY LANGUAGE. computer-oriented language, the instructio which are usually in one-to-one correspond with computer instructions.

ASSOCIATIVE STORAGE.–A sto device in which storage locations are identi by their contents, not by names or positions.

ASYNCHRONOUS.–Pertaining to a lacl time coincidence in a set of repeated ev where this term is applied to a computer indicate that the execution of one operatio dependent on a signal that the previ operation is completed.

ASYNCHRONOUS COMPUTER.- computer in which each event or performance of each operation starts as a res of a signal generated by the completion of t previous event or operation, or by t availability of the parts of the compu required for the next event or operation.

ATMOSPHERE.–The whole mass of surrounding the earth, including t troposphere, stratosphere, and the ionosphei

ATTENUATION.–The reduction in tl strength of a signal.

AUDIOFREQUENCY (af).–A frequenc which can be detected as a sound by the huma ear. The range of audiofrequencies extenc approximately from 20 to 20,000 cycles pe second.

AUTODYNE CIRCUIT.—A circuit in which the same elements and vacuum tube are used as an oscillator and as a detector. The output has a frequency equal to the difference between the frequencies of the received signal and the oscillator signal.

AUTOMATIC.—Pertaining to a process or device that, under specified conditions, functions without intervention by a human operator.

AUTOMATIC CARRIAGE.—A control mechanism for a typewriter or other listing device that can automatically control the feeding, spacing, skipping, and ejecting of paper or preprinted forms.

AUTOMATIC CODING.—The machine-assisted preparation of machine language routines.

AUTOMATIC COMPUTER.—A computer that can perform a sequence of operations without intervention by a human operator.

AUTOMATIC DATA PROCESSING.—Data processing largely performed by automatic means.

AUTOMATIC GAIN CONTROL (agc).—A method of automatically regulating the gain of a receiver so that the output tends to remain constant though the incoming signal may vary in strength.

AUTOMATIC VOLUME CONTROL (avc).—See Automatic Gain Control.

AUTOMATION.—(1) The implementation of processes by automatic means. (2) The theory, art, or technique of making a process more automatic. (3) The investigation, design, development, and application of methods of rendering processes automatic, self-moving, or self-controlling. (4) The conversion of a procedure, a process, or equipment to automatic operation.

AUTOTRANSFORMER.—A transformer in which part of the primary winding is used as a secondary winding, or vice versa.

AUXILIARY OPERATION.—An offline operation performed by equipment not under control of the central processing unit.

AUXILIARY STORAGE.—(1) A storage that supplements another storage. (2) In flowcharting, an offline operation performed by equipment not under control of the central processing unit.

AVALANCHE DIODE.—A diode that conducts current only above a certain "breakdown" voltage, by virtue of high-field impact ionization (avalanche). Useful for voltage-limiting or microwave generation. See also IMPATT diode, avalanche multiplication.

AVALANCHE MULTIPLICATION.—A high-field effect in semiconductors which leads to an increase in current. High-energy charge carriers create additional carriers by impact ionization of valence electrons. See IMPATT Diode.

AZIMUTH.—The angular measurement in a horizontal plane and in a clockwise direction, beginning at a point oriented to north.

BAND OF FREQUENCIES.—The frequencies existing between two definite limits.

BAND-PASS FILTER.—A circuit designed to pass with nearly equal response all currents having frequencies within a definite band, and to reduce substantially the amplitudes of currents of all frequencies outside the band.

BASE.—(1) A reference value. (2) A number that is multiplied by itself as many times as indicated by an exponent. (3) Same as radix. (4) See floating-point base. (5) Along with emitter and collector, one of the three semiconductor regions of the bipolar type of transistor. See BIPOLAR TRANSISTOR.

BASE ADDRESS.—A given address from which an absolute address is derived by combination with a relative address.

BATCH PROCESSING.—(1) Pertaining to the technique of executing a set of computer

programs such that each is completed before the next program of the set is started. (2) Pertaining to the sequential input of computer programs or data. (3) Loosely, the execution of computer programs serially.

BATTERY.–Two or more primary or secondary cells connected together electrically. The term does not apply to a single-cell.

BAUD.–A unit of signalling speed equal to the number of discrete conditions or signal events per second. For example, one baud equals one-half dot cycle per second in Morse code, one bit per second in a train of binary signals, and one 3-bit value per second in a train of signals each of which can assume one of eight different states.

BAUD RATE.–A measure of data flow. The number of signal elements per second based on the duration of the shortest element. When each element carries one bit, the Baud rate is numerically equal to bits per second (bps).

BAZOOKA.–See Line-Balance Converter.

B BOX.–Same as index register.

BCD.–Binary-coded decimal notation.

BEAM LEAD.–(for integrated circuits). A deposited metal lead, usually of gold, which projects beyond the edge of the semiconductor chip. Used for both mechanical and electrical contact to the chip.

BEAM-POWER TUBE.–A high vacuum tube in which the electron stream is directed in concentrated beams from the cathode to the plate. Variously termed beam-power tetrode and beam-power pentode.

BEAT FREQUENCY.–A frequency resulting from the heterodyning of two different frequencies. It is numerically equal to the difference between or the sum of these two frequencies.

BEAT NOTE.–See Beat Frequency.

BEGINNING-OF-TAPE MARKER.–A marker on the magnetic tape used to indicate the beginning of the permissible recording area, e.g., a photo reflective strip, a transparent section of tape. Abbreviation BOT.

BENCHMARK.–Originally a surveyor's mark used as a reference point in surveys. In connection with data processors, the benchmark, is a frequently used routine or program selected for the purpose of comparing different makes of data processors. A flowchart in assembly language is written out for each data processor and the execution of the benchmark by each unit is evaluated on paper. It is not necessary to use hardware to measure capability by benchmark.

BIAS.–Vacuum tube–the difference of potential between the control grid and the cathode; transistor–the difference of potential between the base and emitter and the base and collector; magnetic amplifier–the level of flux density in the magnetic amplifier core–under no-signal condition.

BIGFET.–Bipolar Insulated Gate Field-Effect Transistor. A simple integrated circuit combining a field-effect transistor and a bipolar transistor. See FET.

BINARY.–(1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are two possibilities. (2) Pertaining to the number representation system with a radix of two.

BINARY CODE.–A code that makes use of exactly two distinct characters, usually 0 and 1.

BINARY-CODED DECIMAL NOTATION.–Positional notation in which the individual decimal digits expressing a number in decimal notation are each represented by a binary numeral. Abbreviated BCD.

BINARY DIGIT.–In binary notation, either of the characters, 0 and 1.

BINARY NOTATION.–Fixed radix notation where the radix is two.

BIONICS.—A branch of technology relating the functions, characteristics, and phenomena of living systems to the development of hardware systems.

BIPOLAR TRANSISTOR.—A transistor consisting of an emitter, base, and collector whose action depends on the injection of a minority carriers into the base by the emitter and the collection of these minority carriers from the base by the collector. Sometimes called NPN or PNP transistor to emphasize its layered structure.

BIQUINARY CODE.—A mixed radix notation in which each decimal digit to be represented is considered as a sum of two digits of which the first is zero or one with a significance five and the second is 0, 1, 2, 3, or 4 with significance one.

BISTABLE.—Pertaining to a device capable of assuming either one of two stable states.

BIT.—A binary digit.

BIT STRING.—A string of binary digits in which the position of each binary digit is considered as an independent unit.

BLANKING.—See Gating.

BLEEDER.—A resistance connected in parallel with a power supply output to protect equipment from excessive voltages if the load is removed or substantially reduced; to improve the voltage regulation, and to drain the charge remaining in the filter capacitors when the unit is turned off.

BLOCK.—(1) A set of things, such as words, characters, or digits handled as a unit. (2) A collection of contiguous records recorded as a unit. Blocks are separated by block gaps and each block may contain one or more records. (3) A group of bits, or digits, transmitted as a unit. An encoding procedure is generally applied to the group of bits or digits for error control purposes. (4) A group of contiguous characters recorded as a unit.

BLOCKING CAPACITOR.—A capacitor used to block the flow of direct current while permitting the flow of alternating current.

BLOCK DIAGRAM.—A diagram of a system, instrument, or computer in which the principal parts are represented by suitably associated geometrical figures to show both the basic functions and the functional relationships among the parts. Contrast with FLOWCHART.

BLOCK LENGTH.—A measure of the size of a block, usually specified in units such as records, words, computer words, or characters.

BLOCK TRANSFER.—The process of transmitting one or more blocks of data where the data are organized in blocks.

BOOLEAN.—(1) Pertaining to the processes used in the algebra formulated by George Boole. (2) Pertaining to the operations of formal logic.

BOOLEAN ADD.—Same as OR.

BOOLEAN OPERATOR.—A logic operator each of whose operands and whose result have one of two values.

BOOTSTRAP.—A technique or device designed to bring itself into a desired state by means of its own action e.g., a machine routine whose first few instructions are sufficient to bring the rest of itself into the computer from an input device.

BORROW.—An arithmetically negative carry.

BRANCH.—(1) A set of instructions that are executed between two successive decision instructions. (2) Loosely, a conditional jump.

BRANCHPOINT.—A place in a routine where a branch is selected.

BREAK-DOWN VOLTAGE.—The voltage at which an insulator or dielectric ruptures, or at which ionization and conduction take place in a gas or vapor.

BREAKPOINT.–A place in a routine specified by an instruction digit, or other condition, where the routine may be interrupted by external intervention or by a monitor routine.

BREAKER POINTS.–Metal contacts that open and close a circuit at timed intervals.

BRILLIANCE MODULATION.–See Intensity Modulation.

BRUSH.–The conducting material, usually a block of carbon, bearing against the commutator or sliprings through which the current flows in or out.

BUFFER.–(1) A routine or storage used to compensate for a difference in rate of flow of data, or time or occurrence of events, when transmitting data from one device to another. (2) An isolating circuit used to prevent a driven circuit from influencing the driving circuit.

BUFFER AMPLIFIER.–An amplifier used to isolate the output of an oscillator from the effects produced by changes in voltage or loading in following circuits.

BUG.–A mistake or malfunction.

BUNCHER.–The electrode of a velocity-modulated tube which alters the velocity of electrons in the constant current beam causing the electrons to become bunched in a drift space beyond the buncher electrode.

BURST.–(1) To separate continuous-form paper into discrete sheets. (2) In data transmission, a sequence of signals counted as one unit in accordance with some specific criterion or measure.

BUS.–One or more conductors used for transmitting signals or power.

BUS BAR.–A primary power distribution point connected to the main power source.

BYPASS CAPACITOR.–A capacitor used to provide an alternating current path of comparatively low impedance around a circuit element.

BYTE.–A sequence of adjacent binary digits operated upon as a unit and usually shorter than a computer word.

CALCULATOR.–(1) A data processor especially suitable for performing arithmetical operations which require frequent intervention by a human operator. (2) Generally and historically, a device for carrying out logic and arithmetic digital operations of any kind.

CALL.–To transfer control to a specified close subroutine.

CALLING SEQUENCE.–A specified arrangement of instructions and data necessary to set up and call a given subroutine.

CAPACITANCE.–The property of two or more bodies which enables them to store electrical energy in an electrostatic field between the bodies.

CAPACITIVE COUPLING.–A method of transferring energy from one circuit to another by means of a capacitor that is common to both circuits.

CAPACITIVE REACTANCE (X_C).–The opposition offered to the flow of an alternating current by capacitance, expressed in ohms.

CAPACITOR.–Two electrodes or sets of electrodes in the form of plates, separated from each other by an insulating material called the dielectric.

CAPACITOR STORAGE.–A storage device that utilizes the capacitance properties of materials to store data.

CARD COLUMN.–A single line of punch positions parallel to the short edge of a 3 1/4 by 7 3/8 inch punched card.

CARD DECK.–Same as deck.

CARD HOPPER.–The portion of a card processing machine that holds the cards to be

processed and makes them available to a card feed mechanism.

CARD IMAGE.—A one-to-one representation of the hole patterns of a punched card, e.g., a matrix in which a one represents a punch and zero represents the absence of a punch.

CARD ROW.—A single line of punch positions parallel to the long edge of a 3 1/4 by 7 3/8 inch punched card.

CARD STACKER.—The portion of a card processing machine that receives processed cards.

CARRIAGE CONTROL TAPE.—A tape that contains line feed control data for a printing device.

CARRIAGE RETURN.—The operation that prepares for the next character to be printed or displayed at the specified first position on the same line.

CARRIER.—The RF component of a transmitted wave upon which an audio signal or other form of intelligence can be impressed.

CARRY.—(1) One or more digits, produced in connection with an arithmetic operation on one digit place of two or more numerals in positional notation, that are forwarded to another digit place for processing there. (2) The number represented by the digit or digits in (1). (3) Most commonly, a digit as defined in (1), that arises when the sum or product of two or more digits equals or exceeds the radix of the number representation system.

CASCADED CARRY.—In parallel addition, a carry process in which the addition of two numerals results in a partial sum numeral and a carry numeral which are in turn added together, this process being repeated until no new carries are generated.

CATCHER.—The electrode of velocity-modulated tube which receives energy from the bunched electrons.

CATHODE (K).—The electrode in a vacuum tube which is the source of electron emission. Also a negative electrode.

CATHODE BIAS.—The method of biasing a tube by placing the biasing resistor in the common cathode return circuit, making the cathode more positive, rather than the grid more negative, with respect to ground.

CATHODE FOLLOWER.—A vacuum tube circuit in which the input signal is applied between the control grid and ground, and the output is taken from the cathode and ground. A cathode follower has a high input impedance and a low output impedance.

CATHODE RAY STORAGE.—An electrostatic storage device that utilizes a cathode ray beam for access to the data.

CCD.—Charge Coupled Device. A semiconductor device whose action depends on the storage of electric charge within a semiconductor by an insulated electrode on its surface, with the possibility of selectively moving the charge to another electrode by proper manipulation of voltages on the electrode.

CDI.—Collector Diffusion Isolation. A process for fabricating integrated circuits whereby the collector diffusion also electrically isolates the transistors from one another.

CELL.—(1) The storage for one unit of information, usually one character or one word in data processing. (2) A single unit that produces a direct voltage by converting chemical or radiant energy into electrical energy.

CENTRAL PROCESSING UNIT.—A unit of a computer that includes the circuits controlling the interpretation and execution of instructions. Synonymous with main frame. Abbreviated CPU.

CENTRAL PROCESSOR.—A central processing unit.

CHAD.—The piece of material removed when forming a hole or notch in a storage medium such as punched tape or punched cards.

CHADLESS.–Pertaining to the punching of tape in which chad does not result.

CHAIN PRINTER.–A printer in which the type slugs are carried by the links of a revolving chain.

CHANGE DUMP.–A selective dump of those storage locations whose contents have changed.

CHANNEL.–(1) A path along which signals can be sent, e.g., data channel, output channel. (2) The portion of a storage medium that is accessible to a given reading or writing station, e.g., track, band.

CHARACTER.–(1) A letter, digit, or other symbol that is used as part of the organization, control, or representation of data. A character is often in the form of a spatial arrangement of adjacent or connected strokes.

CHARACTER CHECK.–A check that verifies the observance of rules for the formation of characters.

CHARACTER PRINTER.–A device that prints a single character at a time.

CHARACTER RECOGNITION.–The identification of graphic, phonic, or other characters by automatic means.

CHARACTER SET.–A set of unique representations called characters e.g., the 26 letters of the English alphabet, 0 and 1 of the Boolean alphabet, and the set of signals in the Morse code alphabet.

CHARACTER STRING.–A string consisting solely of characters.

CHARACTER SUBSET.–A selection of characters from a character set, comprising all characters which have a specified common feature. For example, in the definition of character set, digits 0 through 9 constitute a character subset.

CHARACTERISTIC IMPEDANCE (Z_O).–The ration of the voltage to the current at every point along a transmission line on which there are no standing waves.

CHARGE CARRIER.–A carrier of electrical charge within the crystal of a solid-state device, such as an electron or a hole.

CHIP.–Any small piece of semiconductor, especially one fabricated for semiconductor devices.

CHOKE.–A coil which impedes the flow of alternating current of a specified frequency range because of its high inductive reactance at that range.

CHOPPING.–See Limiting.

CIRCUIT.–The complete path of an electric current.

CIRCUIT BREAKER.–An electromagnetic or thermal device that opens a circuit when the current in the circuit exceeds a predetermined amount. Circuit breakers can be reset.

CIRCULAR MIL.–An area equal to that of a circle with a diameter of 0.001 inch. It is used for measuring the cross section of wires.

CLAMPING CIRCUIT.–A circuit which maintains either amplitude extreme of a waveform at a certain level of potential.

CLASS A OPERATION.–Operation of a vacuum tube so that plate current flows through the entire operating cycle and distortion is kept to a minimum.

CLASS AB OPERATION.–Operation of a vacuum tube with grid bias so that the operating point is approximately halfway between Class A and Class B.

CLASS B OPERATION.–Operation of a vacuum tube with bias at or near cut-off so that plate current flows during approximately one-half cycle.

CLASS C OPERATION.–Operation of a vacuum tube with bias considerably beyond

cut-off so that plate current flows for less than one-half cycle.

CLEAR.—To place one or more storage locations into a prescribed state, usually zero or the space character.

CLIPPING.—See Limiting.

CLOCK.—(1) A device that generates periodic signals used for synchronization. (2) A register whose content changes at regular intervals in such a way as to measure time.

CLOCK PULSE.—A synchronization signal provided by a clock.

CLOCK TRACK.—A track on which a pattern of signals has been recorded to provide a time reference.

CLOSED SUBROUTINE.—A subroutine that can be stored at one place and can be linked to one or more calling routines.

COAXIAL CABLE.—A transmission line consisting of two conductors concentric with and insulated from each other.

COBOL.—(Common Business Oriented Language) A business data processing language.

CODE.—(1) A set of unambiguous rules specifying the way in which data may be represented, e.g., the set of correspondences in the standard code for information interchange. (2) In telecommunications, a system of rules and conventions according to which the signals representing data can be formed, transmitted, received, and processed. (3) In data processing, to represent data or a computer program in a symbolic form that can be accepted by a data processor. (4) To write a routine.

CODER.—A person mainly involved in writing but not designing computer programs.

COEFFICIENT OF COUPLING (K).—A numerical indication of the degree of coupling existing between two circuits, expressed in terms of either a decimal or a percentage.

COLLATE.—To combine items from two or more ordered sets into one set having a specified order not necessarily the same as any of the original sets.

COLLATING SEQUENCE.—An ordering assigned to a set of items, such that any two sets in that assigned order can be collated.

COLLATOR.—A device to collate, merge, or match sets of punched cards or other documents.

COLLECTOR.—Along with the emitter and base, one of the three regions of the bipolar type of transistor. See Bipolar Transistor.

COLUMN.—(1) A vertical arrangement of characters or other expressions. (2) Loosely, a digit place.

COMMAND.—(1) A control signal. (2) Loosely, an instruction in machine language.

COMMAND LANGUAGE.—A source language consisting primarily of procedural operators, each capable of invoking a function to be executed.

COMMON FIELD.—A field that can be accessed by two or more independent routines.

COMMUNICATION LINK.—The physical means of connecting one location to another for the purpose of transmitting and receiving data.

COMMUTATOR.—The copper segments on the armature of a d.c. motor or generator. It is cylindrical in shape and is used to pass power into or from the brushes. It is a switching device.

COMPILE.—To prepare a machine language program from a computer program written in another programming language by making use of the overall logic structure of the program, or generating more than one machine instruction for each symbolic statement, or both, as well as performing the function of an assembler.

COMPILER.—A program that compiles.

COMPLEMENT.–(1) A number that can be derived from a specified number by subtracting it from a second specified number. For example, in radix notation, the second specified number may be a given power of the radix or one less than a given power of the radix. The negative of a number is often represented by its complement.

COMPLETE CARRY.–In parallel addition, a technique in which all of the carries are allowed to propagate.

COMPUTER.–A data processor that can perform substantial computation, including numerous arithmetic or logic operations, without intervention by a human operator during the run.

COMPUTER CODE.–A machine code for a specific computer.

COMPUTER INSTRUCTION.–A machine instruction for a specific computer.

COMPUTER NETWORK.–A complex consisting of two or more interconnected computers.

COMPUTER PROGRAM.–A series of instructions or statements, in a form acceptable to a computer, prepared in order to achieve a certain result.

COMPUTER WORD.–A sequence of bits or characters treated as a unit and capable of being stored in one computer location. Synonymous with machine word.

CONCURRENT.–Pertaining to the occurrence of two or more events or activities within the same specified interval of time.

CONDENSER.–See Capacitor.

CONDITIONAL JUMP.–A jump that occurs if specified criteria are met.

CONDUCTANCE.–The ability of a material to conduct or carry an electric current. It is the reciprocal of the resistance of the material, and is expressed in ohms.

CONDUCTIVITY.–A measure of the ability of a material to act as a path for electron flow. It is the opposite of resistivity and is expressed in mhos per meter.

CONDUCTOR.–Any material suitable for carrying electric current.

CONNECTOR.–(1) On a flowchart, the means of representing the convergence of more than one flowline into one, or the divergence of one flowline into more than one. It may also represent a break in a single flowline for continuation in another area. (2) A means of representing on a flowchart a break in a line of flow.

CONSECUTIVE.–Pertaining to the occurrence of two sequential events without the intervention of any other such event.

CONSOLE.–That part of a computer used for communication between the operator or maintenance engineer and the computer.

CONTINUOUS WAVES.–Radio waves which maintain a constant amplitude and a constant frequency.

CONTRAST.–In optical character recognition, the differences between color or shading of the printed material on a document and the background on which it is printed.

CONTROL GRID (G_1).–The electrode of a vacuum tube other than a diode upon which the signal voltage is impressed in order to control the plate current.

CONTROL–GRID–PLATE TRANSCONDUCTANCE.–See Transconductance.

CONTROL PANEL.–A part of a computer console that contains manual controls.

CONVERSION TRANSCONDUCTANCE (gc).–A characteristic associated with the mixer function of vacuum tubes, and used in the same manner as transconductance is redundant. It is the ratio of the IF current in the primary of the first IF transformer to the RF signal voltage producing it.

CONVERT.—To change the representation of data from one form to another, e.g., to change numerical data from binary to decimal or from cards to tape.

CONVERTER.—See Mixer.

CONVERTER TUBE.—A multielement vacuum tube used both as a mixer and as an oscillator in a superheterodyne receiver. It creates a local oscillator frequency and combines it with an incoming signal to produce an intermediate frequency.

COPY.—To reproduce data in a new location or other destination, leaving the source data unchanged, although the physical form of the result may differ from that of the source. For example, to copy a deck of cards onto a magnetic tape. Contrast with duplicate.

CORE.—A magnetic material that affords an easy path for magnetic flux lines in a coil.

CORRECTIVE MAINTENANCE.—Maintenance specifically intended to eliminate an existing fault.

CORRECTIVE MAINTENANCE TIME.—Time, either scheduled or unscheduled, used to perform corrective maintenance.

COULOMB.—A unit of electrical charge; the quantity of electrical charge created by a steady flow of one ampere for one second.

COUNTER.—A device such as a register or storage location used to represent the number of occurrences of an event.

COUNTER E.M.F.—Counter electromotive force; an e.m.f. induced in a coil or armature that opposes the applied voltage.

COUNTING CIRCUIT.—A circuit which receives uniform pulses representing units to be counted and produces a voltage in proportion to the frequency.

COUPLED IMPEDANCE.—The effect produced in the primary winding of a transformer by the current flowing in the secondary winding.

COUPLING.—The association of two circuits in such a way that energy may be transferred from one to the other.

COUPLING ELEMENT.—The means by which energy is transferred from one circuit to another; the common impedance necessary for coupling.

CPU.—Central Processing Unit.

CR.—The carriage return character.

CRIPPLED MODE.—A system operating with less than full capability but able to produce a useful product, usually caused by a major component malfunction.

CRITICAL COUPLING.—The degree of coupling which provides the maximum transfer of energy between two resonant circuits at the resonant frequency.

CRITICAL FREQUENCY.—The limiting frequency below which an electromagnetic wave is refracted back to earth by, and above which it penetrates through, an ionospheric layer at vertical incidence (straight up).

CROSSTALK.—The unwanted energy transferred from one circuit, called the "disturbing" circuit, to another circuit, called the "disturbed" circuit.

CRT DISPLAY.—Cathode Ray Tube display.

CRYSTAL (Xtal).—(1) A natural substance, such as quartz or tourmaline, which is capable of producing a voltage stress when under pressure, or producing pressure when under an applied voltage. Under stress it has the property of responding only to a given frequency when cut to a given thickness. (2) A nonlinear element such as galena or silicon in which case the piezoelectric characteristic is not exhibited.

CRYSTAL MIXER.—A device which employs the nonlinear characteristic of a crystal

(non-piezoelectric type) and a point contact to mix two frequencies.

CRYSTAL OSCILLATOR.—An oscillator circuit in which a piezoelectric crystal is used to control the frequency and to reduce frequency instability to a minimum.

CURRENT (1).—Flow of electrons, measured in amperes.

CURRENT LIMITER.—A protective device similar to a fuse, usually used in high amperage circuits.

CUTOFF (co).—The minimum value of negative grid bias which prevents the flow of plate current in a vacuum tube.

CUTOFF FREQUENCY.—The frequency at which the intrinsic gain of a device falls to some predetermined value. For example, the frequency at which the gain of a bipolar transistor in a common-emitter amplifier configuration is equal to unity.

CUTOFF LIMITING.—Limiting the maximum output voltage of a vacuum-tube circuit by driving the grid beyond cut-off.

CYBERNETICS.—That branch of learning which brings together theories and studies on communication and control in living organisms and machines.

CYCLE.—(1) An interval of space or time in which one set of events or phenomena is completed. (2) Any set of operations that is repeated regularly in the same sequence. The operations may be subject to variations on each repetition.

CYCLIC SHIFT.—A shift in which the data moved out of one end of the storing register and reentered into the other end, as in a closed loop.

DAMPED WAVES.—Waves which decrease exponentially in amplitude.

DARLINGTON PAIR.—A circuit, often integrated, consisting of two bipolar transistors with the collectors connected together and the emitter of one connected to the base of the other. The combination behaves like a very high gain transistor. See supergain transistor.

DATA.—(1) A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by humans or automatic means. (2) Any representations such as characters or analog quantities to which meaning is or might be assigned.

DATA BANK.—A comprehensive collection of libraries of data.

DATA FLOW CHART.—A flowchart representing the path of data through a problem solution. It defines the major phases of the processing as well as the various data media used.

DATA HIERARCHY.—A data structure consisting of sets and subsets such that every subset of a set is of lower rank than the data of the set.

DATA MEDIUM.—(1) The material in or on which a specific physical variable may represent data. (2) The physical quantity which may be varied to represent data.

DATA PROCESSING.—The execution of a systematic sequence of operations performed upon data. Synonymous with information processing.

DATA PROCESSOR.—A device capable of performing data processing, including desk calculators, punched card machines, and computers.

DATA REDUCTION.—The transformation of raw data into a more useful form.

DEBUG.—To detect, locate, and remove mistakes from a routine or malfunctions from a computer. Synonymous with troubleshoot.

DECIBEL (dB).—A term meaning one-tenth of a bel. The ratio of a change in power after attenuation or amplification.

DECIMAL.—Pertaining to the number representation system with a radix of ten.

DECIMAL DIGIT.—In decimal notation, one of the characters 0 through 9.

DECIMAL NOTATION.—A fixed radix notation where the radix is ten.

DECIMAL NUMERAL.—A decimal representation of a number.

DECIMAL POINT.—The radix point in decimal representation.

DECISION.—A determination of future action.

DECISION INSTRUCTION.—An instruction that effects the selection of a branch of a program, e.g., a conditional jump instruction.

DESK.—A collection of punched cards. Synonymous with card deck.

DECODE.—To apply a set of unambiguous rules specifying the way in which data may be restored to a previous representation.

DECODER.—(1) A device that decodes. (2) A matrix of logic elements that selects one or more output channels according to the combination of input signals present.

DECOLLATE.—To separate the plies of a multipart form or paper stock.

DECOUPLING NETWORK.—A network of capacitors, chokes, or resistors, placed in leads which are common to two or more circuits to prevent unwanted interstage coupling.

DEFERRED MAINTENANCE.—Maintenance specifically intended to eliminate an existing fault, which did not prevent continued successful operation of the device or program.

DEFLECTION SENSITIVITY (CRT).—The quotient of the displacement of the electron beam at the place of impact by the change in the deflecting field. It is usually expressed in millimeters per volt applied between the deflection electrodes, or in millimeters per gauss of the deflecting magnetic field.

DEGENERATION.—The process whereby a part of the output signal of an amplifying device is returned to its input circuit in such a manner that it tends to cancel part of the input.

DEIONIZATION POTENTIAL.—The potential at which ionization of the gas within a gas-filled tube ceases and conduction stops.

DELAY.—The amount of time by which an event is retarded.

DELEAVE.—Same as decollate.

DELIMITER.—A flag that separates and organizes items of data. Synonymous with separator.

DEMODULATION.—See Detection.

DEMULTIPLEXER.—A hardware device (or software routine) to de-interleave two or more data streams transmitted on a single channel.

DEPLETION LAYER.—The region in a semiconductor where essentially all charge carriers have been swept out by the electric field which exists there.

DESCRIPTOR.—In information retrieval, a word used to categorize or index information. Synonymous with keyword.

DESTRUCTIVE READ.—A read process that also erases the data from the source.

DETECTION.—The process of separating the modulation component from the received signal.

DEVELOPMENT TIME.—That part of operating time used for debugging new routines or hardware.

DIAGNOSTIC.—Pertaining to the detection and isolation of a malfunction or mistake.

DIELECTRIC.–An insulator; a term applied to the insulating material between the plates of a capacitor.

DIELECTRIC CONSTANT.–The ratio of the capacitance of a capacitor with a dielectric between the electrodes to the capacitance with air between the electrodes.

DIFFERENTIATING CIRCUIT.–A circuit which produces an output voltage substantially in proportion to the rate of change of the input voltage.

DIFFRACTION.–The bending of a radio wave into the region behind an obstacle.

DIFFUSION.–Spontaneous intermingling of substances, as, for example, the diffusion of an impurity into a semiconductor at high temperatures to create a desired concentration of N or P charge carriers.

DIGIT.–A symbol that represents one of the non-negative integers smaller than the radix. For example, in decimal notation a digit is one of the characters from Ø through 9. Synonymous with NUMERIC CHARACTER.

DIGITAL.–Pertaining to data in the form of digits.

DIGITAL COMPUTER.–(1) A computer in which discrete representation of data is mainly used. (2) A computer that operates on discrete data by performing arithmetic and logic processes on these data.

DIGITIZE.–To use numeric characters to express or represent data.

DIGITIZER.–A software routine or hardware device which converts analog (input) data to digital (output) data.

DIGIT PUNCH.–A punch in rows 1, 2,..., 9 of a punched card.

DIMINISHED RADIX COMPLEMENT.–Same as radix-minus-one complement.

DIODE.–Vacuum tube–a two element tube that contains a cathode and plate; semiconductor–a material of either germanium or silicon that is manufactured to allow current to flow in only one direction. Diodes are used as rectifiers and detectors.

DIODE DETECTOR.–A detector circuit employing a diode tube.

DIP.–Dual In-line Package. A circuit package somewhat longer than it is wide, with the leads coming out of the two long sides.

DIPOLE ANTENNA.–Two metallic elements, each approximately one quarter wavelength long, which radiate RF energy fed to them by the transmission line.

DIRECT ACCESS.–(1) Pertaining to the process of obtaining data from, or placing data into, storage where the time required for such access is independent of the location of the data most recently obtained or placed in storage. (2) Pertaining to a storage device in which the access time is effectively independent of the location of the data. (3) Synonymous with random access (1).

DIRECT ADDRESS.–An address that specifies the location of an operand.

DIRECT WAVE.–A radio wave that is propagated directly through space from transmitter to receiving antenna.

DIRECTLY HEATED CATHODE.–A filament cathode which carries its own heating current for electron emission, as distinguished from an indirectly heated cathode.

DIRECTOR (antenna).–A parasitic antenna placed in front of a radiating element so that RF radiation is aided in the forward direction.

DISASTER DUMP.–A dump made when a nonrecoverable program error occurs.

DISCRETE.–Pertaining to distinct elements or to representation by means of distinct elements such as characters.

DISPLAY.—A visual presentation of data.

DISTORTION.—The production of an output waveform which is not a true reproduction of the input waveform. Distortion may consist of irregularities in amplitude, frequency, or phase.

DISTRIBUTED CAPACITANCE.—The capacitance that exists between the turns in a coil or choke, or between adjacent conductors or circuits, as distinguished from the capacitance which is concentrated in a capacitor.

DISTRIBUTED INDUCTANCE.—The inductance that exists along the entire length of a conductor, as distinguished from the self-inductance which is concentrated in a coil.

DOCUMENT.—(1) A medium and the data recorded on it for human use. (2) By extension, any record that has permanence and that can be read by man or machine.

DOCUMENT REFERENCE EDGE.—In character recognition, a specified document edge with respect to which the alignment of characters is defined.

DOCUMENTATION.—(1) The creating, collecting, organizing, storing, citing, and disseminating of documents or the information recorded in documents. (2) A collection of documents or information on a given subject.

DONOR.—An impurity that can make a semiconductor N-type by donating extra "free" electrons to the conduction band. The free electrons are carriers of negative charge.

DOORKNOB TUBE.—A doorknob-shaped vacuum tube designed for ultra-high-frequency circuits. This tube has short electron transit time and low interelecrode capacitance, because of the close spacing and small size of electrodes.

DOPING.—The introduction of an impurity into the crystal lattice of a semiconductor to modify its electronic properties—for example, adding boron to silicon to make the material more P-type.

DOUBLE PRECISION.—Pertaining to the use of two computer words to represent a number.

DOWNTIME.—The time interval during which a device is malfunctioning.

DRAIN.—Along with the source and gate, one of the three regions of a unipolar or field-effect transistor. See FET.

DROP OUT.—(1) In magnetic tape, a recorded signal whose amplitude is less than a predetermined percentage of a reference signal. (2) In data transmission, a momentary loss in signal, usually due to the effect of noise or system malfunction.

DROPPING RESISTOR.—A resistor used to decrease a given voltage to a lower value.

DRY ELECTROLYTIC CAPACITOR.—An electrolytic capacitor using a paste instead of a liquid electrolyte. See Electrolytic Capacitor.

DUMP.—(1) To copy the contents of all or part of a storage, usually from an internal storage into an external storage. (2) A process as in (1). (3) The data resulting from the process as in (1).

DUODECIMAL.—(1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are twelve possibilities. (2) Pertaining to the numeration system with a radix of twelve.

DUPLICATE.—To copy so that the result remains in the same physical form as the source, e.g., to make a new punched card with the same pattern of holes as an original punched card. Contrast with copy.

DYNAMIC CHARACTERISTICS.—The relation between the instantaneous plate voltage and plate current of a vacuum tube as the voltage applied to the grid is moved; thus, the characteristics of a vacuum tube during operation.

DYNAMIC DUMP.–A dump that is performed during the execution of a computer program.

DYNAMIC STORAGE.–A device storing data in a manner that permits the data to move or vary with time such that the specified data are not always available for recovery. Magnetic-drum and disc storage are nonvolatile dynamic storage. An acoustic delay line is a volatile dynamic storage.

DYNATRON.–A negative resistance device; particularly, a tetrode operating on that portion of its i_p versus e_p characteristic where secondary emission exists to such an extent that an increase in plate voltage actually causes a decrease in plate current, and therefore, makes the circuit behave like a negative resistance.

DYNAMIC STORAGE ALLOCATION.–A storage allocation technique in which the location of computer programs and data is determined by criteria applied at the moment of need.

EAM.–Electrical Accounting Machine.

EBCDIC.–Extended Binary-Coded-Decimal Interchange Code. An 8-bit binary code for data notation which is divided into a zone group and a digit group of four bits each. The bit positions are numbered the same as bytes, left to right, Ø through 7. It allows for future code expansion of up to 256 characters.

ECCLES-JORDON CIRCUIT (Trigger circuit).–A direct coupled multivibrator circuit possessing two conditions of stable equilibrium. Also known as a flip-flop circuit.

EDDY CURRENT.–Induced circulating currents in a conducting material that are caused by a varying magnetic field.

EDIT.–To modify the form or format of data, e.g., to insert or delete characters such as page numbers or decimal points.

EDP.–Electronic Data Processing.

EFFECTIVE ADDRESS.–The address that is derived by applying any specified indexing or indirect addressing rules to the specified address and that is actually used to identify the current operand.

EFFECTIVE VALUE.–The equivalent heating value of an alternating current or voltage, as compared to a direct current or voltage. It is 0.707 times the peak value of a sine wave. It is also called the RMS value.

EFFICIENCY.–The ratio of output to input power, generally expressed as a percentage.

ELECTRIC FIELD.–A space in which an electric charge will experience a force exerted upon it.

ELECTRODE.–A terminal at which electricity passes from one medium into another.

ELECTROLYTE.–A water solution of a substance which is capable of conducting electricity. An electrolyte may be in the form of either a liquid or a paste.

ELECTROLYTIC CAPACITOR.–A capacitor employing a metallic plate and an electrolyte as the second plate separated by a dielectic which is produced by electrochemical action.

ELECTROMAGNET.–A magnet made by passing current through a coil of wire wound on a soft iron core.

ELECTROMAGNETIC FIELD.–A space field in which electric and magnetic vectors at right angles to each other, travel in a direction at right angles to both.

ELECTROMOTIVE FORCE (E.M.F.).–The force that produces an electric current in a circuit.

ELECTRON.–A negatively charged particle of matter.

ELECTRON EMISSION.–The liberation of electrons from a body into space under the

influence of heat, light, impact, chemical disintegration, or potential difference.

ELECTRONIC DATA PROCESSING.—(1) Data processing largely performed by electronic devices. (2) Pertaining to data processing equipment that is predominantly electronic such as an electronic digital computer.

ELECTRONIC SWITCH.—A circuit which causes a start-and-stop action or a switching action by electronic means.

ELECTRONIC VOLTMETER.—See Vacuum Tube Voltmeter.

ELECTROSTATIC FIELD.—The field of influence between two charged bodies.

ELECTROSTATIC STORAGE.—A storage device that stores data as electrostatically charged areas on a dielectric surface.

ELEVEN-PUNCH.—A punch in the second row from the top, on a Hollerith punched card. Synonymous with x-punch.

EMERGENCY MAINTENANCE.—Maintenance specifically intended to eliminate an existing fault, which makes continued production work unachievable.

EMERGENCY MAINTENANCE TIME.—Time, usually unscheduled, used to perform corrective maintenance.

EMITTER.—Along with the base and collector, one of the three regions of the bipolar type of transistor. See Bipolar Transistor.

ENABLE.—The application of a pulse that prepares a circuit for some subsequent action.

ENCODE.—To apply a set of unambiguous rules specifying the way in which data may be represented such that a subsequent decoding is possible.

ENCODER.—A device capable of translating from one method of expression to another method of expression,e.g., translating a message, "add the contents of A to the contents of B, " into a series of binary digits. Contrasted with (decoder).

END-AROUND CARRY. A carry from the most significant digit place to the least significant place.

END-OF-FILE MARK.—A special character of magnetic tape used to indicate the end of a set of data.

END-OF-TAPE MARK.—A mark on a magnetic tape used to indicate the end of the permissible recording area, e.g., a photo reflective strip, a transparent section of tape, a particular bit pattern. Abbreviation EOT.

ENERGY GAP (of a semiconductor).—The region, according to quantum mechanics, of forbidden electron energies. The gap lies between the energy band for valence electrons and the energy band for conduction electrons.

ENTRY CONDITIONS.—The initial data and control conditions to be satisfied for successful execution of a given routine.

ENTRY POINT.—In a routine, any place to which control can be passed.

EPITAXIAL LAYER.—A deposited layer of material having the same crystallographic characteristics as the substrate material.

EQUIVALENT CIRCUIT.—A diagrammatic arrangement of coils, resistors, and capacitors, representing the effects of a more complicated circuit in order to permit easier analysis.

ERASE.—To obliterate information from a storage medium, e.g., to clear, to overwrite.

ERROR.—Any discrepancy between a computed, observed, or measured quantity and the true, specified, or theoretically correct value or condition.

ERROR DETECTING CODE.—A code in which each expression conforms to specific rules of construction, so that if certain errors occur in

an expression the resulting expression will not conform to the rules of construction and, thus, the presence of the errors is detected. Synonymous with self-checking code.

ERROR MESSAGE.–An indication that an error has been detected.

ERROR RANGE.–The difference between the highest and lowest error values.

ERROR RATIO.–The ratio of the number of data units in error to the total number of data units.

EXCESS THREE CODE.–A binary coded decimal notation in which each decimal digit N is represented by the binary numeral of N plus three.

EXCLUSIVE OR.–A logic operator having the property that if P is a statement and Q is a statement, then P exclusive OR Q is true if either but not both statements are true, false if both are true or both are false. P exclusive OR Q is often represented b by $P \oplus Q$, $P \veebar Q$. Contrast with OR.

EXECUTIVE ROUTINE.–A routine that controls the execution of other routines.

EXPONENT.–In a floating point representation, the numeral, of a pair of numerals representing a number, that indicates the power to which the base is raised.

EXTRINSIC CONDUCTIVITY.–Electrical conductivity dependent on the impurities in the material. (Compare intrinsic conductivity.)

FALSE ADD.–To form a partial sum, i.e., to add without carries.

FARAD (f).–The unit of capacitance.

FAULT.–(1) A physical condition that causes a device, a component, or an elemnet to fail to perform in a required manner, e.g., a short circuit, a broken wire, an intermittent connection.

FEEDBACK.–A transfer of energy from the output circuit of a device back to its input.

FEEDBACK LOOP.–The components and processes involved in correcting or controlling a system by using part of the output as input.

FERRITE.–An iron compound frequently used in the construction of magnetic cores.

FET.–Field-Effect Transistor. A transistor consisting of a source, gate, and drain, whose action depends on the flow of majority carriers past the gate from source to drain. The flow is controlled by the transverse electric field under the gate. See unipolar transistor, IGFET.

FIC.–Film Integrated Circuit. See Thin-film Integrated Circuit.

FIELD.–(1) The space containing electric or magnetic lines of force. (2) In a record, a specified area used for a particular category of data, e.g., a group of card columns used to represent a wage rate, a set of bit locations in a computer word used to express the address of the operand.

FIELD INTENSITY.–Electrical or magnetic strength of a field.

FIELD WINDING.–The coil used to provide the magnetizing force in motors and generators.

FILAMENT.–See Directly Heated Cathode.

FILE.–A collection of related records treated as a unit. For example, one line of invoice may form an item, a complete invoice may form a record, the complete set of such records may form a file; the collection of inventory control files may form a library, and the libraries used by an organization are known as its data bank.

FILE GAP.–An area on a data medium intended to be used to indicate the end of a file, and possibly, the start of another. A file gap is frequently used for other purposes, in particular, as a flag to indicate the end or beginning of some other group of data.

FILE LAYOUT.—The arrangement and structure of data in a file, including the sequence and size of its components. By extension, a file layout might be the description thereof.

FILE MAINTENANCE.—The activity of keeping a file up to date by adding, changing or deleting data.

FILE SEPARATOR.—The information separator intended to identify a logical boundary between items called "files." Abbreviated FS.

FILTER.—(1) A device or program that separates data, signals, or material in accordance with specified criteria. (2) A mask. (3) A combination of circuit elements designed to pass a definite range of frequencies, attenuating all others.

FIRING POTENTIAL.—The controlled potential at which conduction through a gas-filled tube begins.

FIRST DETECTOR.—See Mixer.

FIXED BIAS.—A bias voltage of constant value, such as one obtained from a battery, power supply, or generator.

FIXED CAPACITOR.—A capacitor which has no provision for varying its capacitance.

FIXED-CYCLE OPERATION.—An operation that is completed in a specified number of regularly timed execution cycles.

FIXED-POINT PART.—In a floating-point representation, the numeral of a pair of numerals representing a number, that is the fixed-point factor by which the power is multiplied.

FIXED-POINT REPRESENTATION.—A positional representation in which each number is represented by a single set of digits, the position of the radix point being fixed with respect to one end of the set, according to some convention.

FIXED RADIX NOTATION.—A positional representation in which the significances of successive digit positions are successive integral power of a single radix. When the radix is positive, permissible values of each digit range from zero to one less than the radix, and negative integral powers of the radix are used to represent fractions.

FIXED RESISTOR.—A resistor which has no provision for varying its resistance.

FIXED STORAGE.—Storage whose contents are not alterable by computer instructions, e.g., magnetic core storage with a lockout feature, photographic disc. Synonymous with nonerasable storage, permanent storage, read-only storage.

FLAG.—(1) Any of various types of indicators used for identification, e.g., a wordmark. (2) A character that signals the occurrence of some condition, such as the end of a word. (3) Synonymous with mark, sentinel, tag.

FLIP-FLOP.—A circuit or device containing active elements, capable of assuming either one of two stable states at a given time. Synonymous with toggle.

FLOATING-POINT BASE.—In floating point representation, the fixed positive integer that is the base of the power. Synonymous with floating-point radix.

FLOATING-POINT REPRESENTATION.—A number representation system in which each number as represented by a pair of numerals equals one of those numerals times a power of an implicit fixed positive integer base where the power is equal to the implicit base raised to the exponent represented by the other numeral.

Common Notation

0.0001234 or $(0.1234) \times (10^{-3})$

A Floating Representation

1234 - 03

FLOWCHART.–A graphical representation for the definition, analysis, or solution of a problem, in which symbols are used to represent operations, data, flow, equipment, etc.

FLOWCHART SYMBOL.–A symbol used to represent operations, data, flow, or equipment on a flowchart.

FLOWCHART TEXT.–The descriptive information that is associated with flowchart symbols.

FLOW DIRECTION.–In flowcharting, the antecedent-to-successor relation, indicated by arrows or other conventions, between operations on a flowchart.

FLOWLINE.–On a flowchart, a line representing a connecting path between flowchart symbols.

FLORESCENCE.–The property of emitting light as the immediate result of electronic bombardment.

FLUX FIELD.–All electric or magnetic lines of force in a given region.

FLY-BACK.–The portion of the time base during which the spot is returning to the starting point. This is usually not seen on the screen of the cathode-ray tube because of gating action or the rapidity with which it occurs.

FORMAT.–The arrangement of data.

FORTRAN.–(FORmula TRANSlating system) A language primarily used to express computer programs by arithmetic formulas.

FRAME.–An area, one recording position long, extending across the width of a magnetic or paper tape perpendicular to its movement. Several bits or punch positions may be included in a single frame through the use of different recording positions across the width of the tape.

FREE ELECTRONS.–Electrons which are loosely held and consequently tend to move at random among the atoms of the material.

FREE OSCILLATIONS.–Oscillatory currents which continue to flow in a tuned circuit after the impressed voltage has been removed. Their frequency is the resonant frequency of the tuned circuit.

FREQUENCY (f).–The number of complete cycles per second existing in any form of wave motion; such as the number of cycles per second of an alternating current.

FREQUENCY DISTORTION.–Distortion which occurs as a result of failure to amplify or attentuate equally all frequencies present in a complex wave.

FREQUENCY MODULATION.–See Modulation.

FREQUENCY OF OPTIMUM TRAFFIC (FOT).–The most reliable frequency at a specified time for ionospheric propagation of a radio wave between two specified points.

FREQUENCY STABILITY.–The ability of an oscillator to maintain its operation at a constant frequency.

FULL-WAVE RECTIFIER CIRCUIT.–A circuit which utilizes both the positive and the negative alternations of an alternating current to produce a direct current.

FUNCTION.–A specific purpose of an entity, or its characteristic action.

FUNCTIONAL DESIGN.–The specification of the working relations between the parts of a system in terms of their characteristic actions.

FUNCTIONAL DIAGRAM.–A diagram that represents the functional relationships among the parts of a system.

FUSE.–A protective device inserted in series with a circuit. It contains a metal that will melt or break when current is increased beyond a specific value for a definite period of time.

GAIN (A).–The ratio of the output power, voltage, or current to the input power, voltage, or current, respectively.

GALVANOMETER.—An instrument used to measure small d.c. currents.

GAS TUBE.—A tube filled with gas at low pressure in order to obtain certain desirable characteristics.

GATE.—(1) Along with the source and drain, one of the three regions of the unipolar or field-effect transistor. See FET. (2) A device having one output channel and one or more input channels, such as the output channel state is completely determined by the input channel states, except during switching transients, e.g., AND GATE; OR GATE.

GATING (Cathode-ray tube).—Applying a rectangular voltage to the grid or cathode of a cathode-ray tube to sensitize it during the sweep time only.

GENERAL PURPOSE COMPUTER.—A computer that is designed to handle a wide variety of problems.

GENERATOR.—A machine that converts mechanical energy into electrical energy.

GRAY CODE.—A binary code in which sequential numbers are represented by binary expressions, each of which differs from the preceding expression in one place only. Synonymous with reflected binary code.

GRID.—A wire, usually in the form of a spiral, that controls the electron flow in a vacuum tube.

GRID CURRENT.—Current which flows between the cathode and the grid whenever the grid becomes positive with respect to the cathode.

GRID DETECTION.—Detection by rectification in the grid circuit of a detector.

GRID LEAK.—A high resistance connected across the grid capacitor or between the grid and the cathode to provide a d.c. path from grid to cathode and to limit the accumulation of charge on the grid.

GRID LIMITING.—Limiting the positive grid voltage (minimum output voltage) of vacuum-tube circuit by means of a large series grid resistor.

GROUND.—A metallic connection with the earth to establish ground potential. Also, a common return to a point of zero RF potential, such as the chassis of a receiver or a transmitter.

GROUND WAVE.—A radio wave that travels close to the earth and reaches the receiving point without being refracted or acted upon by the ionosphere. The ground wave includes all components of a radio wave traveling over the earth except the sky (ionospheric) wave.

GROWN JUNCTION.—PN junction made by controlling the type of impurity in a single crystal while it is being grown from a melt.

GUNN OSCILLATOR.—Microwave oscillator based on the velocity dependence of charge carriers as a function of electric field in some semiconducting materials such as gallium arsenide.

HALF-ADDER.—A combinational logic element having two outputs. S and C, and two inputs, A and B, such that the outputs are related to the inputs according to the following table.

input		output	
A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

S denotes "Sum Without Carry," C denotes "Carry." Two half-adders may be used for performing binary addition.

HALF-WAVE RECTIFICATION.—The process of rectifying an alternating current wherein only one-half of the input cycle is passed and the other half is blocked by the action of the rectifier, thus producing pulsating direct current.

HALF-WORD.–A contiguous sequence of bits or characters which comprises half a computer word and is capable of being addressed as a unit.

HAMMING CODE.–A data code which is capable of being corrected automatically.

HARD TUBE.–A high vacuum electron tube.

HARDWARE.–Physical equipment, as opposed to the computer program or method of use, e.g., mechanical, magnetic, electrical, or electronic devices. Contrast with software.

HARMONIC.–An integral multiple of a fundamental frequency. (The second harmonic is twice the frequency of the fundamental or first harmonic.)

HARMONIC DISTORTION.–See Amplitude Distortion.

HEAD.–A device that reads, writes, or erases data on a storage medium, e.g., a small electromagnet used to read, write, or erase data on a magnetic drum or tape, or the set of perforating, reading, or marking devices used for punching, reading, or printing on paper tape.

HEADER CARD.–A card that contains information related to the data in cards that follow.

HEATER.–The tube element used to indirectly heat a cathode.

HENRY(h).–The basic unit of inductance.

HELMHOLTZ COIL.–A variometer having horizontal and vertical balanced coil windings, used to vary the angle of phase difference between any two similar waveforms of the same frequency.

HERTZ (Hz).–A unit of frequency. Formerly called cycle per second.

HETERODYNE.–To beat or mix two signals of different frequencies.

HEXADECIMAL.–Same as sexadecimal.

HIC.–Hybrid Integrated Circuit, consisting of an assembly of one or more semiconductor devices and a thin-film integrated circuit on a single substrate, usually of ceramic.

HIERARCHY.–See Data Hierarchy.

HIGH-FREQUENCY RESISTANCE.–The resistance presented to the flow of high-frequency current. See Skin-Effect.

HIGH-SPEED CARRY.–Any technique in parallel addition for speeding up carry propagation.

HIT.–A successful comparison of two items of data.

HOLE.–The absence of a valence electron in a semiconductor crystal. Motion of a hole is equivalent to motion of a positive charge.

HOLE PATTERN.–A punching configuration within a card column that represents a single character of a character set.

HOLLERITH.–Pertaining to a particular type of code or punched card utilizing 12 rows per column and usually 80 columns per card.

HORN RADIATOR.–Any open-ended device for concentrating energy from a waveguide and directing this energy into space.

HORSEPOWER (hp).–The English unit of power, equal to work done at the rate of 550 foot-pounds per second. Equal to 746 watts of electrical power.

HYBRID COMPUTER.–A computer for data processing using both analog representation and discrete representation of data.

HYSTERESIS.–A lagging of the magnetic flux in a magnetic material behind the magnetizing force which is producing it.

IC.–See Integrated Circuit.

IDENTIFIER.—A symbol whose purpose is to identify, indicate, or name a body of data.

IDLE TIME.—That part of available time during which the hardware is not being used.

IDP.—See Integrated Data Processing.

IGFET.—A field-effect transistor whose gate is insulated from the semiconductor by a thin intervening layer of insulator, usually thermal oxide.

ILLEGAL CHARACTER.—A character or combination of bits that is not valid according to some criteria, e.g., with respect to a specified alphabet a character that is not a member.

IMAGE FREQUENCY.—An undesired signal capable of beating with the local oscillator signal of a superheterodyne receiver which produces a difference frequency within the bandwidth of the IF channel.

IMPATT DIODE.—Impact Avalanche and Transit Time diode. An avalanche diode used as a high-frequency oscillator or amplifier. Its negative resistance depends upon the transit time of charge carriers through the depletion layer.

IMPEDANCE (Z).—The total opposition offered to the flow of an alternating current. It may consist of any combination of resistance, inductive reactance, and capacitive reactance.

IMPEDANCE COIL.—See Choke.

IMPEDANCE COUPLING.—The use of a tuned circuit or an impedance coil as the common coupling element between two circuits.

IMPULSE.—Any force acting over a comparatively short period of time, such as a momentary rise in voltage.

INCIDENT WAVE.—A term denoting that portion of a radio wave which is about to strike a medium of different propagation characteristic which will result in that wave being refracted, reflected, diffracted, or scattered.

INCONNECTOR.—In flowcharting, a connector that indicates a continuation of a broken flowline.

INDEX.—(1) An ordered reference list of the contents of a file or document together with keys of reference notations for identification or location of those contents. (2) To prepare a list as in (1). (3) A symbol of a numeral used to identify a particular quantity in an array of similar quantities. For example, the terms of an array of similar quantities. For example, the terms of an array represented by X 1/2, X2, ..., X1ØØ have the indexes 1, 2, (4) See INDEX REGISTER.

INDEX REGISTER.—A register whose content may be added to or subtracted from the operand address prior to or during the execution of a computer instruction.

INDEXED ADDRESS.—An address that is modified by the content of an index register prior to or during the execution of a computer instruction.

INDIRECT ADDRESS.—An address that specifies a storage location that contains either a direct address or another indirect address. Contrast with DIRECT ADDRESS.

INDIRECTLY HEATED CATHODE.—A cathode which is brought to the temperature necessary for electron emission by a separate heater element. Compare Directly Heated Cathode.

INDUCTANCE (L).—The property of a circuit which tends to oppose a change in the existing current.

INDUCTION.—The act or process of producing voltage by the relative motion of a magnetic field across a conductor.

INDUCTIVE REACTANCE (X_L).—The opposition to the flow of alternating or pulsating current caused by the inductance of a circuit. It is measured in ohms.

INDUCTOR.–A circuit element designed so that its inductance is its most important electrical property; a coil.

INFINITE.–Extending indefinitely; having innumerable parts, capable of endless division within itself.

INFORMATION.–The meaning that a human assigns to data by means of the known conventions used in their representation.

INFORMATION PROCESSING.–Same as data processing.

INFORMATION RETRIEVAL.–The methods and procedures for recovering specific information from stored data.

INHERITED ERROR.–An error carried forward from a previous step in a sequential process.

INHIBITING SIGNAL.–A signal that prevents an operation from taking place.

INITIAL PROGRAM LOADER.–The procedure that causes the initial part of an operating system or other program to be loaded such that the program can then proceed under its own control. Contrast with BOOTSTRAP. Abbreviated IPL.

INITIALIZE.–To set counters, switches, and addresses to zero or other starting values at the beginning of, or at prescribed points in, a computer routine. Synonymous with prestore.

INJECTION.–In a semiconductor, the introduction of excess minority carriers. Injection can take place at a conducting PN junction or in a region illuminated by light.

IN PHASE.–Applied to the condition that exists when two waves of the same frequency pass through their maximum and minimum values of like polarity at the same instant.

INPUT.–(1) Pertaining to a device, process, or channel involved in the insertion of data or states, or to the data or states involved. (2) One, or a sequence, of input states. (3) Same as INPUT DEVICE. (4) Same as INPUT CHANNEL. (5) Same as INPUT DATA.

INPUT AREA.–An area of storage reserved for input. Synonymous with INPUT BLOCK.

INPUT CHANNEL.–A channel for impressing a state on a device or logic element. Synonymous with INPUT.

INPUT DATA.–Data to be processed. Synonymous with INPUT.

INPUT DEVICE.–The device or collective set of devices used for conveying data into another device. Synonymous with INPUT.

INPUT/OUTPUT.–Pertaining to either input or output, or both. Abbreviated I/O.

INSTALLATION TIME.–Time spent in installing and testing either hardware, or software, or both, unitl they are accepted.

INSTANTANEOUS VALUE.–The magnitude at any particular instant when a value is continually varying with respect to time.

INSTRUCTION.–A statement that specifies an operation and the values or locations of its operands.

INSTRUCTION ADDRESS.–The address that must be used to fetch an instruction.

INSTRUCTION COUNTER.–A counter that indicates the location of the next computer instruction to be interpreted.

INSTRUCTION REGISTER.–A register that stores an instruction for execution.

INSTRUCTION REPERTOIRE.–The set of operations that can be represented in a given operation code.

INTEGRATED CIRCUIT.–A circuit in which many elements are fabricated and interconnected by a single process, as opposed to a "nonintegrated" circuit in which the

transistors, diodes, resistors, etc., are fabricated separately and then assembled.

INTEGRATED DATA PROCESSING.—Data processing in which the coordination of data acquisition and all other stages of data processing is achieved in a coherent system, e.g., a business data processing system in which data for orders and buying are combined to accomplish the functions of scheduling, invoicing, and accounting. Abbreviated IDP.

INTEGRATING CIRCUIT.—A circuit which produces an output voltage substantially in proportion to the frequency and amplitude of the input voltage.

INTENSIFY.—To increase the brilliance of an image on the screen of a cathode-ray tube.

INTENSITY MODUALTION.—The control of the brilliance of the trace on the screen of a cathode-ray tube in conformity with the signal.

INTERELECTODE CAPACITANCE.—The capacitance existing between the electrodes in a vacuum tube.

INTERFACE.—A shared boundary. An interface might be a hardware component to link two devices or it might be a portion of storage or registers accessed by two or more computer programs.

INTERFACE STATES.—Extra donors, acceptors, or traps that may occur at a boundary between a semiconductor and some other material.

INTERLEAVE.—To arrange parts of one sequence of things or events so that they alternate with parts of one or more other sequences of things or events and so that each sequence retains its identity, e.g., to organize storage into banks with independent bases so that sequential data references may be overlapped in a given period of time.

INTERMEDIATE FREQUENCY (IF).—The fixed frequency to which RF carrier waves are converted in a superheterodyne receiver.

INTERNAL STORAGE.—Addressable storage directly controlled by the central processing unit of a digital computer.

INTERPRETER.—(1) A computer program that translates and executes each source language statement before translating and executing the next one. (2) A device that prints on a punched card the data already punched in the card.

INTER-RECORD GAP.—An area on a data medium used to indicate the end of a block or record. Same as RECORD GAP.

INTERRUPT.—To stop a process in such a way that it can be resumed.

INTRINSIC CONDUCTIVITY.—Electrical conductivity of an apparently pure material—i.e., without the presence of any significant impurities.

INVERSE PEAK VOLTAGE.—The highest instantaneous negative potential which the plate can acquire with respect to the cathode without danger of injuring the tube.

INVERSELY.—Inverted or reversed in position or relationship.

INVERT.—To change a physical or logical state to its opposite.

I/O.—An abbreviation for input/output.

ION.—An elementary particle of matter or a small group of such particles having a net positive or negative charge.

ION IMPLANTATION.—Introduction into a semiconductor of selected impurities in controlled regions (via high-voltage ion bombardment) to achieve desired electronic properties.

IONIZATION.—Process by which ions are produced in solids, liquids, or gases.

IONIZATION POTENTIAL.—The lowest potential at which ionization takes place within a gas-filled tube.

IONOSPHERE.–A region composed of highly ionized layers of atmosphere from 70 to 250 miles above the surface of the earth.

ISOGONIC LINE.–An imaginary line drawn through points on the earth's surface where the magnetic deviation is equal.

ISOTROPIC ANTENNA (UNIPOLE).–A hypothetical antenna equally radiating or receiving energy in all directions.

JFET.–Junction Field-Effect Transistor (see FET), in which the gate electrode is formed by a PN junction.

JOULE.–A unit of energy or work. A joule of energy is liberated by one ampere flowing for one second through a resistance of one ohm.

JUMP.–A departure from the normal sequence of executing instructions in a computer. Synonymous with transfer.

JUNCTION.–The interface between two semiconductor regions of differing conductivity. Usually refers to a PN junction, at which the conductivity changes from P-type to N-type.

JUNCTION TRANSISTOR.–A bipolar transistor constructed from interacting PN junctions. The term is used to distinguish junction transistors from other types, such as field-effect and point-contact transistors. See bipolar transistor, PN junction.

JUSTIFY.–(1) To adjust the printing positions of characters on a page so that the lines have the desired length and that both the left and right hand margins are regular. (2) By extension, to shift the contents of a register so that the most or the least significant digit is at some specified position in the register.

KEYPUNCH.–A keyboard actuated device that punches holes in a card to represent data.

KILO (k).–A prefix meaning 1,000.

KILOHERTZ (kHz).–One thousand hertz.

KLYSTRON.–A tube in which oscillations are generated by the bunching of electrons (that is, velocity modulation). This tube utilizes the transit time between two given electrodes to deliver pulsating energy to a cavity resonator in order to sustain oscillations within the cavity.

LABEL.–One or more characters used to identify a statement or an item of data in a computer program.

LACED CARD.–A punched card that has a lace-like appearance, usually without information content.

LAG.–(1) The delay between two events. (2) The amount one wave is behind another in time; expressed in electrical degrees.

LAMINATED CORE.–A core built up from thin sheets of metal and used in transformers and relays.

LANGUAGE.–A set of representations, conventions, and rules used to convey information.

LASER.–Light Amplification by Stimulated Emission of Radiation. In the laser, excited electrons give up their excitation in step with the light that is passing by to add energy to the transmitted light. Some lasers can generate or amplify extremely pure colors, in very narrow beams often with very high intensity.

LEAD.–The opposite of lag. Also, a wire or connection.

LEADER.–The blank section of tape at the beginning of a reel of tape.

LEAKAGE.–The electrical loss due to poor insulation.

LECHER LINE.–A section of open-wire transmission line used for measurements of standing waves.

LED.–Light-Emitting Diode. A semiconductor device in which the energy of minority carriers in combining with holes is

converted to light. Usually, but not necessarily, constructed as a PN junction device.

LEFT-JUSTIFY.—(1) To adjust the printing positions of characters on a page so that the left margin of the page is regular. (2) By extension, to shift the contents of a register so that the most significant digit is at some specified position of the register.

LEVEL.—The degree of subordination in a hierarchy.

LIBRARY.—(1) A collection of organized information used for study and reference. (2) A collection of related files.

LIBRARY ROUTINE.—A proven routine that is maintained in a program library.

LIFETIME.—Term used to describe the life of a minority charge carrier in a semiconductor crystal—for example, how long a free electron exists in a P-type material before it combines with a hole and is neutralized.

LIMITING.—Removal by electronic means of one or both extremities of a waveform at a predetermined level.

LINEAR.—Having an output which varies in direct proportion to the input.

LINE-BALANCE CONVERTER.—A device used at the end of a coaxial line to isolate the outer conductor from ground.

LINE OF FORCE.—A line in an electric or magnetic field that shows the direction of the force.

LINE PRINTER.—A device that prints all characters of a line as a unit.

LINE PRINTING.—The printing of an entire line of characters as a unit.

LINKAGE.—In programming, coding that connects two separately coded routines.

LIST.—An ordered set of items.

LOAD.—(1) The impedance to which energy is being supplied. (2) The power that is being delivered by any power producing device. The equipment that uses the power from the power producing device. (3) In programming, to enter data into storage or working registers.

LOAD-AND-GO.—An operating technique in which there are no stops between the loading and execution phases of a program, and which may include assembling or compiling.

LOCAL OSCILLATOR.—The oscillator used in a superheterodyne receiver, the output of which is mixed with the desired RF carrier to form the intermediate frequency.

LOCATION.—Any place in which data may be stored.

LOGICAL FILE.—A collection of one or more logical records.

LOGIC ELEMENT.—A device that performs a logic function.

LOGIC INSTRUCTION.—An instruction that executes an operation that is defined in symbolic logic, such as AND, OR, NOR.

LOGIC SHIFT.—A shift that affects all positions.

LOGIC SYMBOL.—(1) A symbol used to represent a logic element graphically. (2) A symbol used to represent a logic operator.

LOOP.—A sequence of instructions that is executed repeatedly until a terminal condition prevails.

LOOSE COUPLING.—Less than critical coupling; coupling providing little transfer of energy.

LOWEST USABLE FREQUENCY (LUF).—The LUF, based on the signal-to-noise ratio, varies as the power or the bandwidth is varied. An increase in power or a decrease in bandwidth will lower LUF, and a decrease in power or an increase in bandwidth will raise the

LUF. A small change in power will not materially effect the LUF.

LPE.–Liquid Phase Epitaxy. The formation of an epitaxial layer by placing the substrate in contact with a molten liquid and allowing crystallization on the substrate to take place. See VPE and Epitaxial Layer.

LSA DIODE.–Limited Space-charge Accumulation diode. A microwave oscillator diode similar to the Gunn diode (see Gunn oscillator) but attaining higher power or higher frequency by avoiding the formation of "domains" or regions of nonuniform distribution of charge.

LSI.–Large Scale Integration. (At the beginning of the LSI era a count of 100 gates qualified for LSI. Today an 8-bit CPU can be fabricated on a single chip.)

MACHINE CODE.–An operation code that a machine is designed to recognize.

MACHINE INSTRUCTION.–An instruction that a machine can recognize and execute.

MACHINE LANGUAGE.–A language that is used directly by a machine.

MACHINE WORD.–Same as computer word.

MACRO COMMAND.–A program entity formed by a string of standard, but related, commands which are put into effect by means of a single macro command. Any group of frequently used commands can be combined into a macro command. The many becomes one.

MACRO INSTRUCTION.–An instruction in a source language that is equivalent to a specified sequence of machine instructions.

MACROPROGRAMMING.–Programming with macro instructions.

MAGNETIC AMPLIFIER.–A saturable reactor type device that is used in a circuit to amplify or control.

MAGNETIC CARD.–A card with a magnetic surface on which data can be stored by selective magnetization of portions of the flat surface.

MAGNETIC CIRCUIT.–The complete path of magnetic lines of force.

MAGNETIC CORE.–A configuration of magnetic material that is, or is intended to be, placed in a spatial relationship to current-carrying conductors and whose magnetic properties are essential to its use. It may be used to concentrate an induced magnetic field as in a transformer induction coil, or armature, to retain a magnetic polarization for the purpose of storing data, or for its nonlinear properties as in a logic element. It may be made of such material as iron, iron oxide, or ferrite and in such shapes as wires, tapes, toroids, rods, or thin film.

MAGNETIC DELAY LINE.–A delay line whose operation is based on the time of propagation of magnetic waves.

MAGNETIC DISC.–A flat circular plate with a magnetic surface on which data can be stored by selective magnetization of portions of the flat surface.

MAGNETIC DRUM.–A right circular cylinder with a magnetic surface on which data can be stored by selective magnetization of portions of the curved surface.

MAGNETIC FIELD.–The space in which a magnetic force exists.

MAGNETIC FLUX.–The total number of lines of force issuing from a pole of a magnet.

MAGNETIC HYSTERESIS LOOP.–A closed curve showing the relation between the magnetization force and the induction of magnetization in a magnetic substance when the magnetized field (force) is carried through a complete cycle.

MAGNETIC INK.–An ink that contains particles of a magnetic substance whose presence can be detected by magnetic sensors.

MAGNETIC STORAGE.—A storage device that utilizes the magnetic properties of materials to store data, e.g., magnetic cores, tapes, and films.

MAGNETIC TAPE.—(1) A tape with a magnetic surface on which data can be stored by selective polarization of portions of the surface. (2) A tape of magnetic material used as the constituent in some forms of magnetic cores.

MAGNETIC THIN FILM.—A layer of magnetic material, usually less than one micron thick, often used for logic or storage elements.

MAGNETIZE.—To convert a material into a magnet by causing the molecules to rearrange.

MAGNETO.—A generator which produces alternating current and has a permanent magnet as its field.

MAGNETOSTRICTION.—A change in physical size of a magnetic material produced by the effect of a magnetic field.

MAGNETRON.—A vacuum-tube oscillator containing two electrodes, in which the flow of electrons from cathode to anode is controlled by an externally applied magnetic field.

MAIN FRAME.—Same as central processing unit.

MAIN STORAGE.—The general-purpose storage of a computer. Usually, main storage can be accessed directly by the operating registers.

MAINTENANCE.—Any activity intended to eliminate faults or to keep hardware or programs in satisfactory working condition, including tests, measurements, replacements, adjustments, and repairs.

MAINTENANCE TIME.—Time used for hardware maintenance. It includes preventive maintenance time and corrective maintenance time.

MAJORITY CARRIER.—The mobile charge carrier (hole or electron) that predominates in a semiconductor material—for example, electrons in a N-type region.

MANTISSA.—The fractional part of a logarithm.

MARGINAL CHECK.—A preventive maintenance procedure in which certain operating conditions, such as supply voltage or frequency, are varied about their nominal values in order to detect and locate incipiently defective parts.

MASK.—(1) Pattern or template used in photolithographic-like processes employed in making integrated circuits. The pattern prescribes regions of the circuit electrical leads, etc. (2) A pattern of characters that is used to control the retention or elimination of portions of another pattern of characters. (3) A filter.

MASS STORAGE DEVICE.—A device having a large storage capacity, e.g., magnetic disc, magnetic drum.

MASTER FILE.—A file that is either relatively permanent, or that is treated as an authority in a particular job.

MATCH.—To check for identity between two or more items of data.

MATCHED IMPEDANCE.—The condition which exists when two coupled circuits are so adjusted that their impedances are equal.

MATHEMATICAL MODEL.—A mathematical representation of a process, device, or concept.

MATRIX.—(1) In mathematics, a two-dimensional rectangular array of quantities. Matrices are manipulated in accordance with the rules of matrix algebra. (2) In computers, a logic network in the form of an array of input leads and output leads with logic elements connected at some of their intersections. (3) By extension, an array of any number of dimensions.

MATRIX STORAGE.—Storage, the elements of which are arranged such that access to any location requires the use of two or more

coordinates, e.g., cathode ray storage, magnetic core storage.

MAXIMUM USABLE FREQUENCY (MUF).—The upper limit of the frequencies which can be used at a specified time for radio transmission between two points involving propagation by refraction from the regular ionized layers of the ionosphere. (Frequencies higher than the MUF may be transmitted by sporatic and scattered reflections.)

MEDIUM.—The material, or configuration thereof, on which data are recorded. e.g., paper tape, cards, magnetic tape. Synonymous with data medium.

MEG (mega) (M).—A prefix meaning one million.

MEGAHERTZ (MHz).—One million hertz.

MEGGER.—A test instrument used to measure insulation resistance and other high resistances. It is a portable hand-operator d-c generator used as an ohmmeter.

MEGOHM.—A million ohms.

MEMORY.—Same as storage.

MERGE.—To combine items from two or more similarly ordered sets into one set that is arranged in the same order. Contrast with collate.

MESA STRUCTURE.—A device structure fabricated by selective etching which leaves flat portions of the original surface ("mesas") projecting above the neighboring regions. The mesa technique is often used to limit the extent of the electronically active material to the area of the mesa. Compare Planar Structure.

METALLIC INSULATOR.—A shorted quarter-wave section of a transmission line which acts as an electrical insulator at a frequency corresponding to its quarter-wave length.

MICRO (μ).—A prefix meaning one-millionth.

MICROINSTRUCTION MEMORY.—The part of a computer system into which information can be inserted and held for future use. Storage and Memory are interchangeable expressions. Memories accept and hold binary numbers only. Memory types are core, disk, drum, and semiconductor.

MICROPROCESSOR.—The microprocessor is a Central Processing Unit fabricated on one or two chips. While no standard design is visible in existing units, a number of well-delinated areas are present in all of them: Arithmetic & Logic Unit, Control Block, and Register Array. When joined to a memory storage system, the resulting combination is referred to in today's usage as a microcomputer. It should be added that each microprocessor is supplied with an Instruction Set, and this software manual may be just as important to the user as the hardware.

MICROSECOND (μs).—One-millionth of a second.

MILLIAMPERE (m).—A prefix meaning one-thousandth.

MISSIAMPERE (ma).—One-thousandth of an ampere.

MINORITY CARRIER.—The nonpredominant mobile charge carrier in a semiconductor—for example, electrons in a P-type region.

MIXER.—A vacuum tube or crystal and suitable circuit used to combine the incoming and local-oscillator frequencies to produce an intermediate frequency. See Beat Frequency.

MHO.—The unit of conductance.

MNEMONIC SYMBOL.—A symbol chosen to assist the human memory, e.g., an abbreviation such as "mpy" for "multiply."

MODEM.—(MOdulator-DEModulator) A device that modulates signals transmitted over communication facilities.

MODULATION.—The process of varying the amplitude (amplitude modulation), the

frequency (frequency modulation), or the phase (phase modulation) of a carrier wave in accordance with other signals in order to convey intelligence. The modulating signal may be an audiofrequency signal, video signal (as in television), or electrical pulses or tones to operate relays, etc.

MODULATOR.—The circuit which provides the signal, that varies the amplitude, frequency or phase of the resultant wave in a transmitter.

MODULE.—(1) A program unit that is discrete and identifiable with respect to compiling, combining with other units, and loading, e.g., the input to, or output from, an assembler, compiler, linkage editor, or executive routine. (2) A packaged functional hardware unit designed for use with other components.

MODULUS.—The number of permissible numbers used in a process or system. For example, if only the integers from -15 to +15 inclusive are considered, 31 is the modulus of this set of numbers.

MONITOR.—Software or hardware that observes, supervises, controls, or verifies the operations of a system.

MONOLITH.—A semiconductor chip containing a multiplicity of devices interconnected into an integrated circuit.

MONOSTABLE.—Pertaining to a device that has one stable state.

MOS.—Metal Oxide Semiconductor. The structure of an MOS Field Effect Transistor (FET) is metal over silicon oxide over silicon. The metal electrode is the gate; the silicon oxide is the insulator; and carrier doped regions in the silicon substrate become the drain and source. The result is a sandwich very much like a capacitor, which explains why MOS is slower than bipolar since the 'capacitor sandwich' must charge up before current can flow. The three great advantages of MOS are its process simplicity because of reduced fabrication stages; the savings in chip real estate resulting in functional density; and the ease of interconnection on chip. The qualities enable MOS to break the LSI barrier, something bipolar is just beginning to achieve. The hand-held calculator and the microprocessor are triumphs of MOS-LSI technology.

MOSFET.—A field-effect transistor containing a metal gate over thermal oxide over silicon. The MOSFET structure is one way to make an IGFET.

MOTOR–GENERATOR.—A motor and a generator with a common shaft used to convert line voltages to other voltages or frequencies.

MULTICRYSTALLINE.—See Polycrystalline.

MULTIELECTRODE TUBE.—A vacuum tube containing more than three electrodes associated with a single electron stream.

MULTIPLE PUNCHING.—Punching more than one hole in the same column of a punched card by means of more than one keystroke.

MULTIPLEX.—To interleave or simultaneously transmit two or more messages on a single channel.

MULTIPROCESSING.—Pertaining to the simultaneous execution of two or more computer programs or sequences of instructions by a computer or computer network.

MULTIPROCESSOR.—A computer employing two or more processing units under integrated control.

MULTIPROGRAMMING.—Pertaining to the concurrent execution of two or more programs by a computer.

MULTIVIBRATOR.—A type of relaxation oscillator for the generation of nonsinusoidal waves in which the output of each of its two tubes is coupled to the input of the other to sustain oscillations.

MUTUAL CONDUCTANCE (gm).—See Transconductance.

MUTUAL INDUCTANCE.–A circuit property existing when the relative position of two inductors causes the magnetic lines of force from one to link with the turns of the other.

NAND.–A logic operator having the property that if P is a statement, Q is a statement, R is a statement...., then the NAND OF P, Q, R... is true if at least one statement is false, false if all statements are true. Synonymous with NOT-AND.

NATURAL LANGUAGE.–A language whose rules reflect and describe current usage rather than prescribe usage.

N-CORE-PER-BIT STORAGE.–A storage device that employs n magnetic cores for each bit to be stored.

NDR.–See Nondestructive Read.

NEGATE.–To perform the logic operation NOT.

NEGATIVE CHARGE.–The electrical charge carried by a body which has an excess of electrons.

NEGATIVE FEEDBACK.–See Degeneration.

NEON BULB.–A glass bulb containing two electrodes in neon gas at low pressure.

NETWORK.–Any electrical circuit containing two or more interconnected elements.

NEUTRALIZATION.–The process of nullifying the voltage fed back through the interelectrode capacitance of an amplifier tube, by providing an equal voltage of opposite phase; generally necessary only with triode tubes.

NEUTRONS.–A particle having the weight of a proton but carrying no electric charge. It is located in the nucleus of an atom.

NIXIE.–An electronic solid state device which displays letters or numerals on its luminous surface.

NODE.–A zero point; specifically, a current node is a point of zero current and a voltage node is a point of zero voltage.

NOISE.–(1) Random variations of one or more characteristics of any entity such as voltage, current, or data. (2) A random signal of known statistical properties of amplitude, distribution and spectral density. (3) Loosely, any disturbance tending to interfere with the normal operation of a device or system.

NONDESTRUCTIVE READ.–A read process that does not erase the data in the source. Abbreviated NDR.

NONINDUCTIVE CAPACITOR.–A capacitor in which the inductive effects at high frequencies are reduced to the minimum.

NONINDUCTIVE CIRCUIT.–A circuit in which inductance is reduced to a minimum or negligible value.

NONLINEAR.–Having an output which does not vary in direct proportion to the input.

NON-RETURN-TO-ZERO (MARK) RECORDING.– A method of recording in which ones are represented by a change in the condition of magnetization; zeros are represented by the absence of change. Abbreviated NRZ(M).

NON-RETURN-TO-ZERO RECORDING.–A method of recording in which the change between the state of magnetization representing either zero or one provides the reference condition. Synonymous with non-return-to-reference recording. Abbreviated NRZ.

NO-OP.–An instruction that specifically instructs the computer to do nothing, except to proceed to the next instruction in sequence.

NOR.–A logic operator having the property that if P is a statement, Q is a statement, R is a statement..., then the NOR of P, Q, R... is true if all statements are false, false if at least one statement is true. P NOR Q is often represented

by a combination of "OR" and "NOT" symbols, such as ~ (PVQ). P NOR Q is also called "neither P nor Q." Synonymous with NOT-OR.

NORMAL DIRECTION FLOW.—A flow in a direction from left to right or top to bottom on a flowchart.

NORMALIZE.—(1) To multiply a variable or one or more quantities occurring in a calculation by a numerical coefficient in order to make an associated quantity assume a nominated value, e.g., to make a definite integral of a variable, or the maximum member of a set of quantities, equal to unity. (2) Loosely, a scale.

NOT.—A logic operator having the property that if P is a statement, then the NOT of P is true if P is false, false if P is true. The NOT of P is often represented by $\overline{P}$, ~P, ¬P, P'.

NOT-AND.—Same as NAND.

NOT-OR.—Same as NOR.

NPN.—A semiconductor structure consisting of a layer of P-type material sandwiched between layers of N-type material, as commonly used in the bipolar type of transistor.

NRZ.—Non-Return-to-Zero recording.

NRZ(M).—Non-Return-to-Zero (Mark) recording.

N-TYPE.—Semiconductor material in which the majority carriers are electrons and are therefore negative.

NUCLEUS.—The central part of an atom that is mainly comprised of protons and neutrons. It is the part of the atom that has the most mass.

NULL.—Zero.

NUMBER.—(1) A mathematical entity that may indicate quantity or amount of units. (2) Loosely, a numeral.

NUMBER REPRESENTATION.—The representation of numbers by agreed sets of symbols according to agreed rules. Synonymous with numeration.

NUMBER REPRESENTATION SYSTEM.—An agreed set of symbols and rules for number representation.

NUMBER SYSTEM.—Loosely, a number representation system.

NUMERAL.—(1) A discrete representation of a number. For example, twelve, 12, XII, 1100 are four different numerals that represent the same number. (2) A numeric word that represents a number.

NUMERIC WORD.—A word consisting of digits and possibly space characters and special characters.

OBJECT CODE.—Output from a compiler or assembler which is itself executable machine code or is suitable for processing to produce executable machine code.

OBJECT MODULE.—A module that is the output of an assembler or compiler and is input to a linkage editor.

OBJECT PROGRAM.—A fully compiled or assembled program that is ready to be loaded into the computer. Synonymous with target program.

OCR.—Optical Character Recognition.

OCTAL.—(1) Pertaining to a characteristic or property involving a selection, choice or condition in which there are eight possibilities. (2) Pertaining to the number representation system with a radix of eight.

OCTET.—A byte composed of eight bits.

ODD-EVEN CHECK.—Same as parity check.

OFFLINE.—Pertaining to equipment or devices not under control of the central processing unit.

OFFLINE STORAGE.—Storage not under control of the central processing unit.

OHM (Ω).—The unit of electrical resistance.

OHMIC CONTACT.–Contact to a semiconductor or other part of a device having low electrical resistance and not showing rectifying behavior. See Rectifying Contact.

OHMMETER.–An instrument for directly measuring resistance in ohms.

ONES COMPLEMENT.–The radix-minus-one complement in binary notation.

ONLINE.–(1) Pertaining to equipment or devices under control of the central processing unit. (2) Pertaining to a user's ability to interact with a computer.

ONLINE STORAGE.–Storage under control of the central processing unit.

OPEN CIRCUIT.–A circuit which does not provide a complete path for the flow of current.

OPENENDED.–Pertaining to a process or system that can be augmented.

OPEN SUBROUTINE.–A subroutine that is inserted into a routine at each place it is used.

OPERAND.–That which is operated upon. An operand is usually identified by an address part of an instruction.

OPERATING SYSTEM.–Software which controls the execution of computer programs and which may provide scheduling, debugging, input/output control, accounting, compilation, storage assignment, data management, and related services.

OPERATING TIME.–That part of available time during which the hardware is operating and assumed to be yielding correct results. It includes development time, production time, and makeup time.

OPERATION.–A program step undertaken or executed by a computer, e.g., addition, multiplication, extraction, comparison, shift, transfer. The operation is usually specified by the operator part of an instruction.

OPERATION CODE.–A code that represents specific operations. Synonymous with instruction code.

OPERATION DECODER.–A device that selects one or more control channels according to the operator part of a machine instruction.

OPERATOR.–(1) In the description of a process, that which indicates the action to be performed on operands. (2) A person who operates a machine.

OPTICAL CHARACTER RECOGNITION.–The machine identification of printed characters through use of light-sensitive devices. Abbreviated OCR.

OPTICAL SCANNER.–(1) A device that scans optically and usually generates an analog or digital signal. (2) A device that optically scans printed or written data and generates their digital representations.

OPTIMUM COUPLING.–See Critical Coupling.

OR.–A logic operator having the property that if P is a statement, Q is a statement, R is a statement..., then the OR of P, Q, R..., is true if at least one statement is true, false if all statements are false. P OR Q is often represented by P + Q, P V Q. Synonymous with inclusive OR, boolean add, logical add. Contrast with exclusive OR.

OR GATE.–A gate that implements the logic "OR" operator.

OSCILLATOR.–A circuit capable of converting direct current into alternating current of a frequency determined by the constant of the circuit.

OSCILLATORY CIRCUIT.–A circuit in which oscillations can be generated or sustained.

OSCILLOGRAPH.–See Oscilloscope.

OSCILLOSCOPE.–An instrument for showing, visually, graphical representations of the waveforms encountered in electrical circuits.

OUTCONNECTOR.—In flowcharting, a connector that indicates a point at which a flowline is broken for continuation at another point.

OUTPUT.—Pertaining to a device, process, or channel involved in an output process, or to the data or states involved.

OUTPUT AREA.—An area of storage reserved for output.

OUTPUT CHANNEL.—A channel for conveying data from a device or logic element.

OUTPUT DATA.—Data to be delivered from a device or program, usually after some processing.

OUTPUT DEVICE.—The device or collective set of devices used for conveying data out of another device.

OUTPUT PROCESS.—The process of delivering data by a system, subsystem, or device.

OUTPUT STATE.—The state occurring on a specified output channel.

OVERDRIVEN AMPLIFIER.—An amplifier designed to distort the input signal waveform by a combination of cut-off limiting and saturation limiting.

OVERFLOW.—That portion of the result of an operation that exceeds the capacity of the intended unit of storage.

OVERLAY.—The technique of repeatedly using the same blocks of internal storage during different stages of a program. When one routine is no longer needed in storage, another routine can replace all or part of it.

OVERLOAD.—A load greater than the rated load of an electrical device.

OXIDE MASKING.—Use of an oxide on a semiconductor to create a pattern in which impurities are diffused or implanted.

OXIM.—Oxide-Isolated Monolith. A method of making integrated circuits in which an oxide layer is introduced to insulate semiconductor regions from each other.

PACK.—To compress data in a storage medium by taking advantage of known characteristics of the data, in such a way that the original data can be recovered, e.g., to compress data in a storage medium by making use of bit or byte locations that would otherwise go unused.

PACKING DENSITY.—The number of useful storage cells per unit of dimension, e.g., the number of bits per inch stored on a magnetic tape or drum track.

PARALLEL.—Pertaining to the concurrent or simultaneous occurrence of two or more related activities in multiple devices or channels.

PARALLEL FEED.—Application of a d.c. voltage to the plate or grid of a tube in parallel with an a.c. circuit so that the d.c. and a.c. components flow in separate paths. Also called shunt feed.

PARALLEL-RESONANT CIRCUIT.—A resonant circuit in which the applied voltage is connected across a parallel circuit formed by a capacitor and an inductor.

PARAMETER.—A variable that is given a constant value for a specific purpose or process.

PARAPHASE AMPLIFIER.—An amplifier which converts a single input into a push-pull output.

PARASITIC SUPPRESSOR.—A resistor in a vacuum-tube circuit to prevent unwanted oscillations.

PARITY BIT.—A check bit appended to an array of binary digits to make the sum of all the binary digits, including the check bit, always odd or always even.

PARITY CHECK.—A check that tests whether the number of ones (or zeros) in an array of binary digits is odd or even.

PARTIAL CARRY.–In parallel addition, a technique in which some or all of the carries are stored temporarily instead of being allowed to propagate immediately.

PASS.–One cycle of processing a body of data.

PASSIVATION.–Treatment of a region of a device to prevent deterioration of electronic properties through chemical action or corrosion. Usually passivation protects against moisture or contaminants.

PATCH.–To modify a routine in a rough or expedient way.

PATTERN RECOGNITION.–The identification of shapes, forms, or configurations by automatic means.

PATTERN SENSITIVE FAULT.–A fault that appears in response to some particular pattern of data.

PEAKING CIRCUIT.–A type of circuit which converts an input to a peaked output waveform.

PEAK PLATE CURRENT.–The maximum instantaneous plate current passing through a tube.

PEAK VALUE.–The maximum instantaneous value of a varying current, voltage, or power. It is equal to 1.414 times the effective value of a sine wave.

PENTODE.–A five-electrode vacuum tube containing a cathode, control grid, screen grid, suppressor grid, and plate.

PERIPHERAL EQUIPMENT.–In a data processing system, any unit of equipment, distinct from the central processing unit, which may provide the system with outside communication.

PERMALLOY.–An alloy of nickel and iron having an abnormally high magnetic permeability.

PERMEABILITY.–A measure of the ease with which magnetic lines of force can flow through a material as compared to air.

PHASE DIFFERENCE.–The time in electrical degrees by which one wave leads or lags another.

PHASE INVERSION.–A phase difference of 180° between two similar waveships of the same frequency.

PHASE-SPLITTING CIRCUIT.–A circuit which produces from the same input waveform two output waveforms which differ in phase from each other.

PHOSPHORESCENCE.–The property of emitting light for some time after excitation by electronic bombardment.

PHOTODIODE.–An optically sensitive diode. Often the current is accurately proportional to the intensity of the incident light.

PHOTOLITHOGRAPHIC PROCESS.–Technique used in making integrated circuits, which uses light and selective masking to develop a fine-scaled pattern of areas in a semiconductor; analogous to processes using photo negatives in offset printing.

PHOTORESIST.–A photosensitive material which, after selective exposure to ultraviolet light, resists the action of a chemical. Used in conjunction with a mask to selectively process certain areas of a semiconductor device.

PIEZOELECTRIC EFFECT.–The effect of producing a voltage by placing a stress, either by compression, by expansion, or by twisting, on a crystal, and, conversely, the effect of producing a stress in a crystal by applying a voltage to it.

PINBOARD.–A perforated board into which pins are manually inserted to control the operation of equipment.

PIN DIODE.–Diode constructed of an I-type (intrinsic) layer between P and N layers

and used in high-speed or high-power microwave switching.

PIPELINE.–Computers which execute serial programs only are referred to as pipeline computers.

PLA.–Programmed Logic Arrays. The PLA is an orderly arrangement of logical AND logical OR functions. Its application is very much like a glorified ROM. It is primarily a combinational logic device.

PLANAR STRUCTURE.–A flat-surfaced device structure fabricated by diffusion and oxide masking, with the junctions terminating on a single plane. The structural planarity is often advantageous for photoresist processing. (Compare Mesa Structure.)

PLATE (P).–The principal electrode in a tube to which the electron stream is attracted. See Anode.

PLATE CIRCUIT.–The complete electrical circuit connecting the cathode and plate of a vacuum tube.

PLATE CURRENT.–The current flowing in the plate circuit of a vacuum tube.

PLATE DETECTION.–The operation of a vacuum tube detector at or near cut-off so that the input signal is rectified in the plate circuit.

PLATE DISSIPATION.–The power in watts consumed at the plate in the form of heat.

PLATE EFFICIENCY.–The ratio of the a.c. power output from a tube to the average d.c. power supplied to the plate circuit.

PLATE IMPEDANCE.–See Plate Resistance.

PLATE-LOAD IMPEDANCE (R_L or Z_L).–The impedance in the plate circuit across which the output signal voltage is developed by the alternating component of the plate current.

PLATE MODULATION.–Amplitude modulation of a class C RF amplifier by varying the plate voltage in accordance with the modulating signal.

PLATE RESISTANCE (r_p).–The internal resistance to the flow of alternating current between the cathode and plate of a tube. It is equal to a small change in plate voltage divided by the corresponding change in plate current, and is expressed in ohms. It is also called a.c. resistance, internal impedance, plate impedance, and dynamic plate impedance. The static plate resistance, or resistance to the flow of direct current is a different value. It is denoted by R_b.

PLUGBOARD.–A perforated board into which plugs are manually inserted to control the operation of equipment.

PN JUNCTION.–Within a crystal, an interface between a P region that conducts primarily by holes and an N region that conducts primarily by electrons.

PNIP.–Semiconductor crystal structure consisting of layers that are P-type, N-type, Intrinsic, and P-type. Used for high-voltage, high-frequency bipolar transistors.

PNP.–Semiconductor crystal structure consisting of an N-type region sandwiched between two P-type regions, as commonly used in bipolar transistors.

PNPN.–A semiconductor crystal structure in which the layers are successively P-type, N-type, P-type, and N-type. When ohmic contacts are made to the various layers, a silicon controlled rectifier (SCR), or thyristor, results.

POINT-CONTACT TRANSISTOR.–The original transistor, invented at Bell Laboratories, which was made by placing sharp metal points in contact with the surface of an N-type semiconductor crystal.

POLARITY.–The character of having magnetic poles, or electric charges.

POLE.–The section of a magnet where the flux lines are concentrated; also where they enter and leave the magnet. An electrode of a battery.

POLLING.–Polling is the method used to identify the source of interrupt requests. When several interrupts occur at one time, the control program decides which one to service first.

POLYCRYSTALLINE.–A material that consists of many small crystallites rather than a single crystal.

POLYPHASE.–A circuit that utilizes more than one phase of alternating current.

POSITIONAL NOTATION.–A numeration system in which a number is represented by means of an ordered set of digits, such that the value contributed by each digit depends upon its position as well as upon its value.

POSITIVE CHARGE.–The electrical charge carried by a body which has become deficient in electrons.

POSITIVE FEEDBACK.–See Regeneration.

POTENTIAL.–The amount of charge held by a body as compared to another point or body. Usually measured in volts.

POTENTIOMETER.–A variable voltage divider; a resistor which has a variable contact arm so that any portion of the potential applied between its ends may be selected.

POWER.–The rate of doing work or the rate of expanding energy. The unit of electrical power is the watt.

POWER AMPLIFICATION.–The process of amplifying a signal to produce a gain in power, as distinguished from voltage amplification. The gain in the ratio of the alternating power output to the alternating power input of an amplifier.

POWER FACTOR.–The ratio of the actual power of an alternating or pulsating current, as measured by a wattmeter, to the apparent power, as indicated by ammeter and voltmeter readings. The power factor of an inductor, capacitor, or insulator is an expression of the losses.

POWER TUBE.–A vacuum tube designed to handle a greater amount of power than the ordinary voltage-amplifying tube.

PREDEFINED PROCESS.–A process that is identified only by name and that is defined elsewhere.

PRESET.–To establish an initial condition, such as the control values of a loop.

PRESTORE.–Same as initialize.

PREVENTIVE MAINTENANCE.–Maintenance specifically intended to prevent faults from occurring during subsequent operation. Contrast with corrective maintenance. Corrective maintenance and preventive maintenance are both performed during maintenance time.

PREVENTIVE MAINTENANCE TIME.–Time, usually scheduled, used to perform preventive maintenance.

PRIMARY CIRCUIT.–The first, in electrical order, of two or more coupled circuits, in which a change in current induces a voltage in the other or secondary circuits; such as the primary winding of a transformer.

PRIME MOVER.–The source of mechanical power used to drive the rotor of a generator.

PROBLEM DESCRIPTION.–(1) In information processing, a statement of a problem. The statement may also include a description of the method of solution, the procedures and algorithms, etc. (2) A statement of a problem. The statement may also include a description of the method of solution, the solution itself, the transformations of data and the relationship of procedures, data, constraints, and environment.

PROBLEM ORIENTED LANGUAGE.–A programming language designed for the convenient expression of a given class of problems.

PROCESS.–A systematic sequence of operations to produce a specified result.

PROCESSOR.—(1) In hardware, a data processor. (2) In software, a computer program that includes the compiling, assembling, translating, and related functions for a specific programming language.

PROGRAM.—(1) A series of actions proposed in order to achieve a certain result. (2) Loosely, a routine. (3) To design, write, and test a program as in (1). (4) Loosely, to write a routine.

PROGRAM COUNTER.—One of the registers in the CPU which holds addresses necessary to step the machine through the program. During the interrupts, the program counter saves the address of the instruction. Branching also requires loading of the return address in the program counter.

PROGRAM LIBRARY.—A collection of available computer programs and routines.

PROGRAM SENSITIVE FAULT.—A fault that appears in response to some particular sequence of program steps.

PROGRAMMER.—A person mainly involved in designing, writing and testing computer programs.

PROGRAMMING.—The design, the writing, and testing of a program.

PROGRAMMING FLOWCHART.—A flowchart representing the sequence of operations in a program.

PROGRAMMING LANGUAGE.—A language used to prepare computer programs.

PROGRAMMING MODULE.—A discrete identifiable set of instructions, usually handled as a unit, by an assembler, a compiler, a linkage editor, a loading routine, or other type of routine or subroutine.

PROPAGATION.—See Wave Propagation.

PROTON.—A positively charged particle in the nucleus of an atom.

P-TYPE.—Semiconductor material in which the majority carriers are holes and are therefore positive.

PULSATING CURRENT.—A unidirectional current which increases and decreases in magnitude.

PULSE REPETITION RATE.—The number of pulses per unit time.

PUNCH.—A perforation, as in a punched card or paper tape.

PUNCHED CARD.—A card punched with a pattern of holes to represent data.

PUNCHED TAPE.—A tape on which a pattern of holes or cuts is used to represent data.

PUNCH POSITION.—A defined location on a card or tape where a hole may be punched.

PUSH-PULL CIRCUIT.—A push-pull circuit usually refers to an amplifier circuit using two vacuum tubes in such a fashion that when one vacuum tube is operating on a positive alternation, the other vacuum tube operates on a negative alternation.

Q.—(1) The symbol used to denote a quantity of electrical charge. (2) The figure of merit of efficiency of a circuit or coil. Numerically it is equal to the inductive reactance divided by the resistance of the circuit or coil.

QUANTIZE.—To subdivide the range of values of a variable into a finite number of nonoverlapping, but not necessarily equal, subranges or intervals, each of which is represented by an assigned value within the subrange.

QUASI-INSTRINSIC.—Descriptive of a semiconductor material whose conductivity is kept low, close to the intrinsic value, by doping with impurities which create carrier-traps lying near the center of the energy gap.

RADIAL TRANSFER.—An input process, or an output process.

RADIATE.–To send out energy, such as RF waves, into space.

RADIATION RESISTANCE.–A fictitious resistance which would dissipate the same power that the antenna dissipates.

RADIOFREQUENCY (RF).–Any frequency of electrical energy capable of propagation into space. Radiofrequencies normally are much higher than sound wave frequencies.

RADIOFREQUENCY AMPLIFICATION.–The amplification of a radio wave by a receiver before detection, or by a transmitter before radiation.

RADIOFREQUENCY CHOKE (RFC).–An aircore or powdered iron core coil used to impede the flow of RF currents.

RADIOFREQUENCY COMPONENT.–See Carrier.

RADIX.–In positional representation, that integer, if it exists, by which the significance of the digit place must be multiplied to give the significance of the next higher digit place.

RADIX COMPLEMENT.–A complement obtained by subtracting each digit from one less than its radix, then adding one to the least significant digit, executing all carries required.

RADIX-MINUS-ONE COMPLEMENT.–A complement obtained by subtracting each digit from one less than the radix.

RADIX NOTATION.–A positional representation in which the significance of any two adjacent digit positions has an integral ratio called the radix of the less significant of the two positions; permissible values of the digit in any position range from zero to one less than the radix of that position.

RADIX POINT.–In radix notation, the real or implied character that separates the digits associated with the integral part of a numeral from those associated with the fractional part.

RALU.–Register, Arithmetic, and Logic Unit. Unlike the discrete ALU package which functions as an Arithmetic and Logic unit only, the ALU in the microprocessor is equipped with a number of registers.

RAM.–Random Access Memory. Random in the sense of providing access to any storage location point in the memory immediately by means of vertical and horizontal co-ordinates. Information may be "written" in or "read" out in the same rapid way.

RANDOM ACCESS.–An access mode in which specific logical records are obtained from or placed into a mass storage file in a nonsequential manner.

RANDOM NUMBERS.–A series of numbers obtained by chance.

RATE, BIT.–The rate at which binary digits, or pulses representing them pass a given point on a communications line or channel.

RATE, CLOCK.–The time rate at which pulses are emitted from the clock. The clock rate determines the rate at which logical or arithmetic gating is performed with a synchronous computer.

RATIO.–The value obtained by dividing one number by another, indicating their relative proportions.

REACTANCE (X).–The opposition offered to the flow of an alternating current by the inductance, capacitance, or both, in any circuit.

READ.–To acquire or interpret data from a storage device, a data medium, or any other source.

READ-IN.–To sense information contained in some source and transmit this information to an internal storage.

READ-OUT.–To sense information contained in some internal storage and transmit this information to a storage external to the computer.

REAL TIME.—Pertaining to the actual time during which a physical process transpires.

REAL TIME INPUT.—Input data inserted into a system at the time of generation by another system.

REAL TIME OUTPUT.—Output data removed from a system at time of need by another system.

RECIPROCAL.—The value obtained by dividing the number 1 by any quantity.

RECOMBINATION.—In a semiconductor, the combining of holes and electrons. Recombination tends to reduce the minority carriers to their equilibrium number after injection has taken place. See Lifetime.

RECTIFIERS.—Devices used to change alternating current to unidirectional current. These may be vacuum tubes, semiconductors such as germanium and silicon, dry-disk rectifiers such as selenium and copper-oxide, and also certain types of crystal.

RECTIFYING CONTACT.—An electrical contact through which current flows easily in one direction (the "forward" direction), but with difficulty or not at all in the reverse direction.

RECORD.—A collection of related items of data, treated as a unit, for example, one line of an invoice may form a record; a complete set of such records may form a file.

RECORD GAP.—An area on a data medium used to indicate the end of a block or record.

RECORDING DENSITY.—The number of bits in single linear track measured per unit of length of the recording medium.

RECORD LAYOUT.—The arrangement and structure of data in a record, including the sequence and size of its components. By extension, a record layout might be the description thereof.

RECORD LENGTH.—A measure of the size of a record, usually specified in units such as words or characters.

REFLECTED IMPEDANCE.—See Coupled Impedance.

REFLECTION.—The phenomenon which, when a radio wave strikes a medium of different propagation characteristics (such as the earth or ionosphere), causes the wave to be returned into the original medium (ionosphere or the earth) with the angles of incidence and of reflection equal and lying in the same plane.

REFLECTOR.—A metallic object placed behind a radiating antenna to prevent RF radiation in an undesired direction and to reinforce radiation in a desired direction.

REFRACTION.—The phenomenon which, when a radio wave or other radiation passes from one medium (such as the stratosphere) to another medium (such as the ionosphere), causes the wave to bend. The angles of incidence and of reflection are not equal or necessarily lying in the same plane.

REGENERATION.—The process of returning a part of the output signal of an amplifier to its input circuit in such a manner that it reinforces the grid excitation and thereby increases the total amplification.

REGISTER.—A device capable of storing a specified amount of data such as one word.

REGISTRATION.—The accurate positioning relative to a reference.

REGULATION (voltage).—The ratio of the change in voltage due to a load to the open-circuit voltage, expressed in per cent.

RELATIVE ADDRESS.—The number that specifies the difference between the absolute address and the base address.

RELATIVE CODING.—Coding that uses machine instructions with relative addresses.

RELAXATION OSCILLATOR.–A circuit for the generation of nonsinusoidal waves by gradually storing and quickly releasing energy either in the electric field of a capacitor or in the magnetic field of an inductor.

RELAY.–An electromechanical switching device that can be used as a remote control.

RELIABILITY.–The probability that a device will perform without failure for a specified time period or amount of usage.

RELOCATE.–In computer programming, to move a routine from one portion of storage to another and to adjust the necessary address references so that the routine, in its new location, can be executed.

RELUCTANCE.–A measure of the opposition that a material offers to magnetic lines of force.

REMOTE ACCESS.–Pertaining to communication with a data processing facility by one or more stations that are distant from that facility.

REMOTE STATION.–Data terminal equipment for communicating with a data processing system from a location that is time, space, or electrically distant.

REPERFORATOR.–REceiving PERFORATOR.

REPETITION INSTRUCTION.–An instruction that causes one or more instructions to be executed an indicated number of times.

RESET.–(1) To restore a storage device to a prescribed initial state, not necessarily that denoting zero. (2) To place a binary cell into the state denoting zero.

RESISTANCE (R).–The opposition to the flow of current caused by the nature and physical dimensions of a conductor.

RESISTOR.–A circuit element whose chief characteristic is resistance; used to oppose the flow of current.

RESONANCE.–The condition existing in a circuit in which the inductive and capacitive reactances cancel each other.

RESONANCE CURVE.–A graphical representation of the manner in which a resonant circuit responds to various frequencies at and near the resonant frequency.

RESTART.–To reestablish the execution of a routine, using the data recorded at a checkpoint.

RETENTIVITY.–The measure of the ability of a material to hold its magnetism.

RHEOSTAT.–A variable resistor.

RIGHT-JUSTIFY.–(1) To adjust the printing positions of characters on a page so that the right margin of the page is regular. (2) To shift the contents of a register so that the least significant digit is at some specified position of the register.

RIPPLE VOLTAGE.–The fluctuations in the ouput voltage of a rectifier, filter, or generator.

RISE TIME.–For an instantaneous change in voltage applied, the time required for the steady-state current to rise from 10 percent to 90 percent of its maximum value.

RMS.–Abbreviation of root mean square. See Effective Value.

ROM.–Read Only Memory. In its virgin state the ROM consists of a mosaic of undifferentiated cells. One type of ROM is programmed by mask pattern as part of the last manufacturing stage. Another, more popular type better known as P/ROM, is programmable in the field with the aid of programmer equipment. Program data stored in ROMs are often called firmware because they cannot be altered. However, another type of P/ROM is now on the market called EPROM which is erasible by ultraviolet irradiation and electrically reprogrammable.

ROUNDING ERROR.—An error due to roundoff.

ROUNDOFF.—To delete the least significant digit or digits of a numeral, and to adjust the part retained in accordance with some rule.

ROUTINE.—A set of coded instructions arranged in proper sequence to direct the computer to perform a desired operation or sequence of operations. A subdivision of a program consisting of two or more instructions that are functionally related; therefore, a program.

ROW.—A horizontal arrangement of characters or other expressions.

ROW BINARY.—Pertaining to the binary representation of data on cards in which the significances of punch positions are assigned along the card rows. For example, each row in an 80-column card may be used to represent 80 consecutive binary digits.

RUN.—A single, continuous performance of a computer program or routine.

SATURABLE REACTOR.—A control device that uses a small d.c. current to control a large a.c. current by controlling core flux density.

SATURATION.—The condition existing in any circuit when an increase in the driving signal produces no further change in the resultant effect.

SATURATION LIMITING.—Limiting the minimum output voltage of a vacuum-tube circuit by operating the tube in the region of plate current saturation (not to be confused with emission saturation).

SATURATION POINT.—The point beyond which an increase in either grid voltage, plate voltage, or both produces no increase in the existing plate current.

SBC.—Standard Buried Collector. A method of making integrated circuits in which diffused collector areas are "buried" by overlying layers.

SCALE.—To adjust the representation of a quantity by a factor in order to bring its range within prescribed limits.

SCALE FACTOR.—A number used as a multiplier, so chosen that it will cause a set of quantities to fall within a given range of values.

SCAN.—To examine sequentially, part by part.

SCHEDULED MAINTENANCE.—Maintenance carried out in accordance with an established plan.

SCHOTTKY BARRIER.—A potential barrier formed between a metal and a semiconductor. The term usually refers to a barrier which is high enough and thick enough to serve as a rectifier but which avoids the slowing-down effects that result from injection of charge in PN junction rectifiers.

SCR.—Silicon Controlled Rectifier. A PNPN device useful for switching and power applications because it can have both high breakdown voltage and high current-carrying capability. See PNPN, Thyristor.

SCRATCHPAD.—This term is applied to information which the processing unit stores or holds temporarily. It is a memory containing subtotals for various unknowns which are needed for final results.

SCREEN DISSIPATION.—The power dissipated in the form of heat on the screen grid as the result of bombardment by the electron stream.

SCREEN GRID (G_2).—An electrode placed between the control grid and the plate of a vacuum tube to reduce interelectrode capacitance.

SEALED JUNCTION.—A PN junction sealed by covering it with an inert material which does not allow troublesome impurities to reach the junction and cause changes in its electrical characteristics. See Passivation.

SEARCH.–To examine a set of items for one or more having a desired property.

SECONDARY.–The output coil of a transformer. See Primary Circuit.

SECONDARY EMISSION.–The emission of electrons knocked loose from the plate, grid, or fluorescent screen of a vacuum tube by the impact or bombardment of electrons arriving from the cathode.

SEGMENT.–(1) To divide a computer program into parts such that the program can be executed without the entire program being in internal storage at any one time. (2) A part of a computer program as in (1).

SELECTION CHECK.–A check that verifies the choice of devices, such as registers, in the execution of an instruction.

SELECTIVE DUMP.–A dump of one or more specified storage locations.

SELECTIVITY.–The degree to which a receiver is capable of discriminating between signals of different carrier frequencies.

SELF-BIAS.–The bias of a tube created by the voltage drop developed across a resistor through which its cathode current flows.

SELF-EXCITED OSCILLATOR.–An oscillator depending on its resonant circuits for frequency determination. See Crystal Oscillator.

SELF-INDUCTION.–The production of a counter-electromotive force in a conductor when its own magnetic field collapses or expands with a change in current in the conductor.

SEMICONDUCTOR.–An element such as silicon or germanium that is intermediate in electrical conductivity between the metals and insulators.

SENSITIVITY.–The degree of response of a circuit to signals of the frequency to which it is tuned.

SEQUENCE.–An arrangement of items according to a specified set of rules.

SEQUENTIAL.–Pertaining to the occurrence of events in time sequence, with little or no simultaneity or overlap of events.

SEQUENTIAL CONTROL.–Defined sequence until a different sequence is explicitly initiated by a jump instruction.

SEQUENTIAL LOGIC.–A circuit arrangement in which the output state is determined by the previous state of the input.

SEQUENTIAL LOGIC ELEMENT.–A device having at least one output channel and one or more input channels, all characterized by discrete states such that the state of each output channel is determined by the previous states of the input channels.

SEQUENTIAL OPERATION.–Pertaining to the performance of operations one after the other.

SERIAL.–(1) Pertaining to the sequential or consecutive occurrence of two or more related activities in a single device or channel.

SERIES FEED.–Application of the d.c. voltage to the plate or grid of a tube through the same impedance in which the alternating current flows. Compare Parallel Feed.

SERIES RESONANCE.–The condition existing in a circuit when the source of voltage is in series with an inductor and capacitor whose reactances cancel each other at the applied frequency and thus reduce the impedance to minimum.

SERIES-RESONANT CIRCUIT.–A resonant circuit in which the capacitor and the inductor are in series with the applied voltage.

SERIES-WOUND.–A motor or generator in which the armature is wired in series with the field winding.

SERVICE ROUTINE.–A routine in general support of the operation of a computer, e.g., an

input-output, diagnostic, tracing, or monitoring routine. Synonymous with UTILITY ROUTINE.

SERVO.—A device used to convert a small movement into one of greater movement or force.

SERVOMECHANISM.—A closed-loop system that produces a force to position an object in accordance with the information that originates at the input.

SET.—(1) A collection. (2) To place a storage device into a specified state, usually other than that denoting zero or space character. (3) To place a binary cell into the state denoting one.

SETUP.—(1) In a computer which consists of an assembly of individual computing units, the arrangement of interconnections between the units, and the adjustments needed for the computer to solve a particular problem. (2) An arrangement of data or devices to solve a particular problem.

SETUP DIAGRAM.—A diagram specifying a given computer setup.

SEXADECIMAL.—(1) Pertaining to a characteristic or property involving a selection, choice, or condition in which there are sixteen possibilities. (2) Pertaining to the numeration system with a radix of sixteen. Synonymous with hexadecimal.

SHIELDING.—A metallic covering used to prevent magnetic or electrostatic coupling between adjacent circuits.

SHIFT.—A movement of data to the right or left.

SHIFT REGISTER.—A register in which the stored data can be moved to the right or left.

SHORT-CIRCUIT.—A low-impedance or zero-impedance path between two points.

SHUNT.—Parallel. A parallel resistor placed in an ammeter to increase its range.

SHUNT FEED.—See Parallel Feed.

SIC.—Silicon Integrated Circuit. An integrated circuit where all the elements such as transistors, diodes, resistors, and capacitors are successively fabricated in or on the silicon and interconnected.

SIGN BIT.—A binary digit occupying the sign position.

SIGN DIGIT.—A digit occupying the sign position.

SIGNIFICANCE.—In positional representation, the factor, dependent on the digit place, by which a digit is multiplied to obtain its additive contribution in the representation of a number.

SIGNIFICANT DIGIT.—A digit that is needed for a certain purpose, particularly one that must be kept to preserve a specific accuracy or precision.

SIGN POSITION.—A position, normally located at one end of a numeral, that contains an indication of the algebraic sign of the number.

SILICON CONTROLLED RECTIFIER.—See SCR.

SINE WAVE.—The curve traced by the projection on a uniform time scale of the end of a rotating arm, or vector. Also known as a sinusoidal wave.

SINGLE-CRYSTAL MATERIAL.—A material all of which consists of a single crystal, as distinct from most materials, which are polycrystalline.

SKEW.—The angular displacement of a symbol or data medium from the intended or ideal placement.

SKIN EFFECT.—The tendency of alternating currents to flow near the surface of a conductor thus being restricted to a small part of the total cross sectional area. This effect increases the resistance and becomes more marked as the frequency rises.

SKY WAVE.–A radio wave that is propagated or acted upon by the ionosphere.

SLICE.–A thin slab of semiconductor, sawed from an ingot for the purpose of making semiconductor devices.

SNAP-BACK DIODE.–A kind of diode which, when switched from a forward to a reverse direction, passes current for a short time and then very rapidly turns off. The sudden change in current is very rich in harmonics. Used as a frequency mulitplier or pulse generator.

SOFT TUBE.–A vacuum tube, the characteristics of which are adversely affected by the presence of gas in the tube (not to be confused with tubes designed to operate with gas inside them).

SOFTWARE.–A set of computer programs, procedures, and possibly associated documentation concerned with the operation of a data processing system, e.g., compilers, library routines, manuals, circuit diagrams.

SOLAR CELL.–Large-area diode in which a PN junction close to the surface of a semiconductor generates electrical energy from light falling on the surface.

SOLENOID.–A multiturn coil of wire wound in a uniform layer or layers on a hollow cylindrical form.

SOLID STATE COMPONENT.–A component whose operation depends on the control of electric or magnetic phenomena in solids, e.g., a transistor, crystal diode, ferrite core.

SOLID-STATE ELECTRONICS.–Designation used to describe devices and circuits fabricated from solid materials such as semiconductors, ferrites, or films, as distinct from devices and circuits making use of electron tube technology.

SORT.–(1) To segregate items into groups according to some definite rules. (2) Same as order.

SORTER.–A person, device, or computer routine that sorts.

SOURCE.–Along with the gate and drain, one of the three regions of the unipolar or field-effect transistor. See FET.

SOURCE LANGUAGE.–The language from which a statement is translated.

SOURCE PROGRAM.–A computer program written in a source language.

SPACE CHARGE.–(1) The electrical charge of carriers in the depletion layer of a semiconductor. (2) The cloud of electrons existing in the space between the cathode and plate in a vacuum tube, formed by the electrons emitted from the cathode in excess of those immediately attracted to the plate.

SPACE CURRENT.–The total current flowing between the cathode and all the other electrodes in a tube. This includes the plate current, grid current, screen-grid current, and any other electrode current which may be present.

SPACE WAVE.–Often called the tropospheric wave. A radio wave that travels entirely through the earth's troposphere.

SPECIAL CHARACTER.–A graphic character that is neither a letter, nor a digit, nor a space character.

SPECIAL PURPOSE COMPUTER.–A computer that is designed to handle a restricted class of problems.

SPOT PUNCH.–A device for punching one hole at a time.

SPREADING RESISTANCE.–The ohmic resistance of a small ohmic contact to a large volume of semiconductor material.

STABILITY.–Freedom from undesired variation.

STANDING WAVE.–A distribution of current and voltage on a transmission line

formed by two sets of waves traveling in opposite directions and characterized by the presence of a number of points of successive maxima and minima in the distribution curves.

STATIC.—A fixed nonvarying condition; without motion.

STATIC CHARACTERISTICS.—The characteristics of a tube with no output load and with d.c. potentials applied to the grid and plate.

STATIC DUMP.—A dump that is performed at a particular point in time with respect to a machine at the end of a run.

STRATOSPHERE.—The part of the earth's atmosphere between the troposphere and the ionosphere.

STORAGE.—(1) Pertaining to a device into which data can be entered, in which they can be held, and from which they can be retrieved at a later time. (2) Loosely, any device that can store data. (3) Synonymous with memory.

STORAGE ALLOCATION.—The assignment of blocks of data to specified blocks of storage.

STORAGE CAPACITY.—The amount of data that can be continued in a storage device.

STORAGE CELL.—An elementary unit of storage.

STORAGE DEVICE.—A device into which data can be inserted, in which they can be retained, and from which they can be retrieved.

STORAGE PROTECTION.—An arrangement for preventing access to storage for either reading, or writing, or both.

STORAGE TIME.—The time required to withdraw the minority carriers from both sides of a PN junction when the junction is switched from a forward to a reverse bias.

STORE.—(1) To transfer an element of information to a device from which the unaltered information can be obtained at a later time, (2) to retain data in a device from which it can be obtained at a later time.

STORED PROGRAM COMPUTER.—A computer controlled by internally stored instructions that can synthesize, store, and in some cases alter instructions as though they were data and that can subsequently execute these instructions.

SUBROUTINE.—A routine that can be part of another routine.

SUBROUTINE CALL.—The subroutine, in object coding, that performs the call function.

SUBSTRATE.—The underlying material upon which a device, circuit, or epitaxial layer is fabricated.

SUNSPOT NUMBERS.—The number of dark irregularly shaped areas on the surface of the sun caused by violent solar eruptions. The spots are counted and then averaged over a period of time to obtain values which are expressed as "smooth sunspot numbers." These smooth sunspot numbers are used to predict the average sunspot activity over a period of time.

SUPERGAIN TRANSISTOR.—A transistor with a common emitter current gain of about a thousand or more, usually fabricated as a Darlington pair.

SUPERHETERODYNE.—A receiver in which the incoming signal is mixed with a locally generated signal to produce a predetermined intermediate frequency.

SUPPRESSOR GRID (G_3).—An electrode used in a vacuum tube to minimize the harmful effects of secondary emission from the plate.

SURFACE STATES.—Extra donors, acceptors or traps, usually undesired, which may occur on a semiconductor surface because of crystal imperfections or contamination and which may vary undesirably with time.

SURFACE WAVE.—A radio wave that travels in contact with the surface of the earth.

SURGE.–Sudden changes of current or voltage in a circuit.

SURGE IMPEDANCE.–See Characteristic Impedance.

SWEEP CIRCUIT.–The part of a cathode-ray oscilloscope which provides a time-reference base.

SWING.–The variation in frequency or amplitude of an electrical quantity.

SWINGING CHOKE.–A choke with an effective inductance which varies with the amount of current passing through it. It is used in some power-supply filter circuits.

SWITCH.–A device or programming technique for making a selection, e.g., a toggle, a conditional jump.

SYMBOL.–A representation of something by reason of relationship, association, or convention.

SYMBOLIC ADDRESS.–An address expressed in symbols convenient to the computer programmer.

SYMBOLIC CODING.–Coding that uses machine instructions with symbolic addresses.

SYMBOLIC LOGIC.–The discipline that treats formal logic by means of a formalized artificial language or symbolic calculus, whose purpose is to avoid the ambiguities and logical inadequacies of natural languages.

SYMBOL STRING.–A string consisting solely of symbols.

SYNCHRONIZATION PULSES.–Pulses introduced by transmitting equipment into the receiving equipment to keep the two equipments operating in step.

SYNCHRO SYSTEM.–An electrical system that gives remote indications or control by means of self-synchronizing motors.

SYNCHRONOUS.–Happening at the same time; having the same period and phase.

SYNTAX.–(1) The structure of expressions in a language. (2) The rules governing the structure of a language.

SYSTEM.–An organized collection of men, machines, and methods required to accomplish a set of specific functions.

TABLE.–A collection of data in which each item is uniquely identified by a label, by its position relative to the other items, or by some other means.

TABLE LOOK-UP.–A procedure for obtaining the function value corresponding to an argument from a table of function values.

TACHOMETER.–An instrument for indicating revolutions per minute.

TANK CIRCUIT.–See Parallel-resonant Circuit.

TAPE DRIVE.–A device that moves tape past a head.

TAPE TO CARD.–Pertaining to equipment or methods that transmit data from either magnetic tape or punched tape to punched cards.

TAPE TRANSPORT.–Same as tape drive.

TAPE UNIT.–A device containing a tape drive, together with reading, and writing heads and associated controls.

TEMPORARY STORAGE.–In programming, storage locations reserved for intermediate results. Synonymous with working storage.

TERMINAL.–A point in a system or communication network at which data can either enter or leave.

TERTIARY WINDING.–A third winding on a transformer or magnetic amplifier that is used as a second control winding.

TETRODE.—A four-electrode vacuum tube containing a cathode, control grid, screen grid, and plate.

THERMAL OXIDE.—On silicon semiconductor devices, an oxide fabricated by exposing the silicon to oxygen at high temperatures. The resulting interface is completely free of ionic impurities and defects.

THERMIONIC EMISSION.—Electron emission caused by heating an emitter.

THERMISTOR.—A resistor that is used to compensate for temperature variations in a circuit.

THERMOCOUPLE.—A junction of two dissimilar metals that produces a voltage when heated.

THERMOCOUPLE AMMETER.—An ammeter which operates by means of a voltage produced by the heating effect of a current passed through the junction of two dissimilar metals. It is used for RF measurements.

THIN FILM.—Loosely, magnetic thin film.

THIN-FILM INTEGRATED CIRCUIT.—A circuit consisting of patterns of tantalum or other materials laid down on a substrate of glass or ceramic, typically larger than silicon integrated circuits. Sometimes designated FIC.

THYRATRON.—A hot-cathode, gas-discharge tube in which one or more electrodes are used to control electrostatically the starting of a unidirectional flow of current.

THYRISTOR.—A PNPN device useful as a controlled rectifier that can conduct high currents by injection of a highly conducting hole-electron plasma. So called by analogy to a thyratron electron tube (same as SCR).

TIGHT COUPLING.—Degree of coupling in which practically all of the magnetic lines of force produced by one coil link a second coil.

TIME SHARE.—To use a device for two or more interleaved purposes.

TOGGLE.—(1) Same as flip-flop. (2) Pertaining to any device having two stable states.

TRACE.—A visible line or lines appearing on the screen of a cathode-ray tube in operation.

TRACING ROUTINE.—A routine that provides a historical record of specified events in the execution of a program.

TRACK.—The portion of a moving storage medium, such as a drum, tape, or disc, that is accessible to a given reading head position.

TRANSCONDUCTANCE (gm).—The ratio of the change in plate current to the change in grid voltage that produced this change in plate current, while all other electode voltages remain constant.

TRANSFORM.—To change the form of data according to specific rules.

TRANSFORMER.—A device composed of two or more coils, linked by magnetic lines of force, used to transfer energy from one circuit to another.

TRANSIENT.—The voltage or current which exists as the result of a change from one steady-state condition to another.

TRANSISTOR.—A semiconductor device that uses a stream of charge carriers to produce active electronic effects. The name was coined from the electrical characteristic of "transfer resistance." As compared with electron tubes, transistors are usually advantageous because of their greater efficiency, lifetime, reliability, and compactness.

TRANSIT TIME.—(1) The time a charge carrier takes to go from one part of a semiconductor to another. For example, in a reverse-biased diode the time a carrier requires to move through the depletion region. (2) The time which electrons take to travel between the cathode and the plate of a vacuum tube.

TRANSLATE.–To transform statements from one language to another without significantly changing the meaning.

TRANSMISSION.–(1) The sending of data from one location and the receiving of data in another location, usually leaving the source data unchanged. (2) The sending of data.

TRANSMISSION LINES.–Any conductor or system of conductors used to carry electrical energy from its source to a load.

TRANSMIT.–To send data from one location and to receive the data at another location.

TRAPATT.–Trapped Plasma Avalanche Transit Time diode. A diode used as a microwave oscillator in a manner analogous to the IMPATT diode.

TRAPS.–Impurities or defects in a semiconductor that can capture an electron or hole and hold it for a period of time. After trapping, the carriers may be released or recombined, with probability depending on trap energy. Recombination of minority carriers is expedited by the presence of "deep" traps, so the lifetime of a minority carrier can be varied by varying the type and concentration of trap impurities.

TRIGGERING.–Starting an action in another circuit, which then functions for a time under its own control.

TRIODE.–A three-electrode vacuum tube, containing a cathode, control grid, and plate.

TROPOSPHERE.–The lowest part of the earth's atmosphere. In this region, which extends from the surface of the earth to the stratosphere, temperature decreases with altitude, clouds form, and all weather phenomena take place.

TROUBLESHOOT.–Same as debug.

TRUNCATE.–To terminate a computational process in accordance with some rule, e.g., to end the evaluation of a power series at a specified term.

TRUNCATION ERROR.–An error due to truncation.

TRUTH TABLE.–A table that describes a logic function by listing all possible combinations of input values and indicating, for each combination, the true output values.

TUNED CIRCUIT.–A resonant circuit.

TUNING.–The process of adjusting a radio circuit so that it resonates at the desired frequency.

TUNNEL DIODE.–A diode that exhibits negative resistance because of tunneling through a thin depletion layer.

TUNNELING.–In quantum mechanics, a process that explains how charge carriers can penetrate insulating regions that are sufficiently thin.

TWELVE PUNCH.–A punch in the top row of a Hollerith punch card. Synonymous with y-punch.

TWO-OUT-OF-FIVE CODE.–A positional notation in which each decimal digit is represented by five binary digits of which two are one kind (e.g., ones) and three are the other kind (e.g., zeros).

TWOS COMPLEMENT.–The radix complement in binary notation.

TYPE FONT.–Type of a given size and style, e.g., 10-point Bodoni Modern.

UNBALANCED LINE.–A transmission line in which the voltages on the two conductors are not equal with respect to ground; for example, a coaxial line.

UNIDIRECTIONAL.–In one direction only.

UNIPOLAR TRANSISTOR.–A transistor such as a FET whose action depends on majority charge carriers only.

UNIT.—(1) A device having a special function. (2) A basic element.

UNIT, ARITHMETIC.—The portion of the hardware of a computer in which arithmethic and logical operations are performed. The arithmetic unit generally consists of an accumulator, some special registers for the storage of operands, and results supplemented by shifting and sequencing circuitry for implementing multiplication, division, and other desired operations.

UNIT CONTROL.—The portion of a computer which directs the sequence of operations interprets the coded instructions, and initiates the proper commands to the computer circuits preparatory to execution.

UNPACK.—To recover the original data from packed data.

UTILITY ROUTINE.—Same as service routine.

VACUUM TUBE.—An evacuated envelope containing two or more electrodes.

VACUUM-TUBE VOLTMETER (VTVM).—A device which uses either the amplifier characteristic or the rectifier characteristic of a vacuum tube or both to measure either d.c. or a.c. voltages. Its input impedance is very high, and the current used to actuate the meter movement is not taken from the circuit being measured. It can be used to obtain accurate measurements in sensitive circuits.

VARACTOR DIODE.—A diode making use of the variation of capacitance that takes place as reverse bias is varied. Can be used as a frequency multiplier, as a tuning element in a tuned circuit, or as a low-noise parametric amplifier.

VARIABLE.—A quantity that can assume any of a given set of values.

VARIABLE-LENGTH RECORD.—Pertaining to a file in which the records are not uniform in length.

VARIABLE-POINT REPRESENTATION.—A positional representation in which the position of the radix point is explicitly indicated by a special character at that position.

VARIABLE μ TUBE.—A vacuum tube in which the control grid is irregularly spaced, so that the grid exercises a different amount of control on the electron stream at different points within its operating range.

VARIOCOUPLER.—Two independent inductors, so arranged mechanically that their mutual inductance (coupling) can be varied.

VARIOMETER.—A variocoupler having its two coils connected in series, and so mounted that the movable coil may be rotated within the fixed coil, thus changing the total inductance of the unit.

VECTOR.—A line used to represent both direction and magnitude.

VELOCITY MODULATION.—A method of modulation in which the input signal voltage is used to change the velocity of electrons in a constant current electron beam so that the electrons are grouped into bunches.

VENN DIAGRAM.—A diagram in which sets are represented by closed regions.

VERIFY.—(1) To determine whether a transcription of data or other operation has been accomplished accurately. (2) To check the results of keypunching.

VIDEO AMPLIFIER.—A circuit capable of amplifying a very wide range of frequencies, including and exceeding the audio band of frequencies.

VOLATILE STORAGE.—A storage device in which stored data are lost when the applied power is removed, e.g., an acoustic delay line.

VOLT (V).—The unit of electrical potential.

VOLTAGE AMPLIFICATION.—The process of amplifying a signal to produce a gain in voltage. The voltage gain of an amplifier is the

ratio of its alternating-voltage output to its alternating-voltage input.

VOLTAGE DIVIDER.—An impedance connected across a voltage source. The load is connected across a fraction of this impedance so that the load voltage is substantially in proportion to this fraction.

VOLTAGE DOUBLER.—A method of increasing the voltage by rectifying both halves of a cycle and causing the outputs of both halves to be additive.

VOLTAGE REGULATION.—A measure of the degree to which a power source maintains its output-voltage stability under varying load conditions.

VPE.—Vapor Phase Epitaxy. The formation of an epitaxial layer by deposition from the vapor phase onto the substrate. See LPE and Epitaxial Layer.

WAFER.—Same as Chip.

WATT (w).—The unit of electrical power.

WATTMETER.—An instrument for measuring electric power in watts.

WAVE.—Generally, an electromagnetic impulse, periodically changing in intensity and traveling through space. More specifically, the graphical representation of the intensity of that impulse over a period of time.

WAVEFORM.—The shape of the wave obtained when instantaneous values of an a.c. quantity are plotted against time in rectangular coordinates.

WAVELENGTH (λ).—The distance, usually expressed in meters, traveled by a wave during the time interval of one complete cycle. It is equal to the velocity divided by the frequency.

WAVE PROPAGATION.—The transmission of RF energy through space.

WIEN-BRIDGE CIRCUIT.—A circuit in which the various values of capacitance and resistance are made to balance with each other at a certain frequency.

WORD.—(1) A character string or a bit string considered as an entity. (2) See alphabetic word, computer word, half-word, machine word, numeric word.

WORD LENGTH.—A measure of the size of a word, usually specified in units such as characters or binary digits.

WRITE.—To record data in a storage device or a data medium. The recording need not be permanent, such as the writing on a cathode ray tube display device.

X.—The symbol for reactance.

X-PUNCH.—Same as eleven-punch.

Y-PUNCH.—Same as twelve-punch.

Z.—The symbol for impedance.

ZENER DIODE.—A voltage-limiting diode with high impedance at low voltages but low impedance above a "breakdown" voltage. Most voltage-limiting diodes break down by impact ionization ("avalanche") rather than by cold-field emission (the Zener effect).

ZEROFILL.—To character fill with the representation of zero.

ZERO SUPPRESSION.—The elimination of nonsignificant zeros in a numeral.

ZONE PUNCH.—A punch in the eleven, twelve, or zero row of a punched card.

ZONE REFINING.—Technique of purifying a semiconductor or other substance by "sweeping" or passing a molten zone through the otherwise solid material.

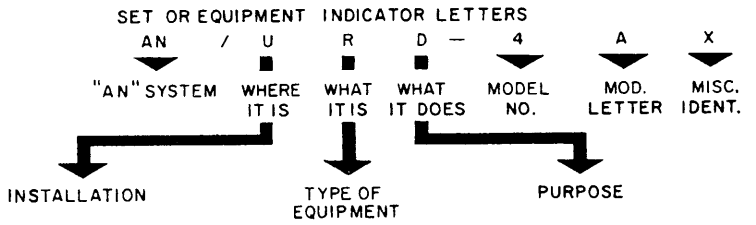
APPENDIX II

JOINT ELECTRONICS TYPE DESIGNATION (AN) SYSTEM

THE *AN* NOMENCLATURE WAS DESIGNED SO THAT A COMMON DESIGNATION COULD BE USED FOR ARMY, NAVY, AND AIR FORCE EQUIPMENT. THE SYSTEM INDICATOR *AN* DOES NOT MEAN THAT THE ARMY, NAVY, AND AIR FORCE USE THE EQUIPMENT, BUT MEANS THAT THE TYPE NUMBER WAS ASSIGNED IN THE *AN* SYSTEM.

AN NOMENCLATURE IS ASSIGNED TO COMPLETE SETS OF EQUIPMENT AND MAJOR COMPONENTS OF MILITARY DESIGN; GROUPS OF ARTICLES OF EITHER COMMERCIAL OR MILITARY DESIGN WHICH ARE GROUPED FOR MILITARY PURPOSES; MAJOR ARTICLES OF MILITARY DESIGN WHICH ARE NOT PART OF OR USED WITH A SET; AND COMMERCIAL ARTICLES WHEN NOMENCLATURE WILL NOT FACILITATE MILITARY IDENTIFICATION AND/OR PROCEDURES.

AN NOMENCLATURE IS NOT ASSIGNED TO ARTICLES CATALOGED COMMERCIALLY EXCEPT AS STATED ABOVE; MINOR COMPONENTS OF MILITARY DESIGN FOR WHICH OTHER ADEQUATE MEANS OF IDENTIFICATION ARE AVAILABLE; SMALL PARTS SUCH AS CAPACITORS AND RESISTORS; AND ARTICLES HAVING OTHER ADEQUATE IDENTIFICATION IN JOINT MILITARY SPECIFICATIONS. NOMENCLATURE ASSIGNMENTS REMAIN UNCHANGED REGARDLESS OF LATER CHANGES IN INSTALLATION AND/OR APPLICATION.



A--AIRBORNE (INSTALLED AND OPERATED IN AIRCRAFT).
B--UNDERWATER MOBILE, SUBMARINE.
C--AIR TRANSPORTABLE (INACTIVATED, DO NOT USE).
D--PILOTLESS CARRIER.
F--FIXED.
G--GROUND, GENERAL GROUND USE (INCLUDES TWO OR MORE GROUND-TYPE INSTALLATIONS).
K--AMPHIBIOUS.
M--GROUND, MOBILE (INSTALLED AS OPERATING UNIT IN A VEHICLE WHICH HAS NO FUNCTION OTHER THAN TRANSPORTING THE EQUIPMENT).
P--PACK OR PORTABLE (ANIMAL OR MAN).
S--WATER SURFACE CRAFT.
T--GROUND, TRANSPORTABLE.
U--GENERAL UTILITY (INCLUDES TWO OR MORE GENERAL INSTALLATION CLASSES, AIRBORNE, SHIPBOARD, AND GROUND).
V--GROUND, VEHICULAR (INSTALLED IN VEHICLE DESIGNED FOR FUNCTIONS OTHER THAN CARRYING ELECTRONIC EQUIPMENT, ETC., SUCH AS TANKS).
W--WATER SURFACE AND UNDERWATER.

A--INVISIBLE LIGHT, HEAT RADIATION.
B--PIGEON.
C--CARRIER.
D--RADIAC.
E--NUPAC.
F--PHOTOGRAPHIC.[1]
G--TELEGRAPH OR TELETYPE.
I--INTERPHONE AND PUBLIC ADDRESS.
J--ELECTROMECHANICAL OR INERTIAL WIRE COVERED.
K--TELEMETERING.
L--COUNTERMEASURES.
M--METEOROLOGICAL.
N--SOUND IN AIR.
P--RADAR.
Q--SONAR AND UNDERWATER SOUND.
R--RADIO
S--SPECIAL TYPES, MAGNETIC, ETC., OR COMBINATIONS OF TYPES.
T--TELEPHONE (WIRE).
V--VISUAL AND VISIBLE LIGHT.
W--ARMAMENT (PECULIAR TO ARMAMENT, NOT OTHERWISE COVERED).
X--FACSIMILE OR TELEVISION.
Y--DATA PROCESSING.

A--AUXILIARY ASSEMBLIES (NOT COMPLETE OPERATING SETS USED WITH OR PART OF TWO OR MORE SETS OR SETS SERIES).
B--BOMBING.
C--COMMUNICATIONS (RECEIVING AND TRANSMITTING).
D--DIRECTION FINDER, RECONNAISSANCE, AND/OR SURVEILLANCE.
E--EJECTION AND/OR RELEASE.
G--FIRE-CONTROL OR SEARCHLIGHT DIRECTING.
H--RECORDING AND/OR REPRODUCING (GRAPHIC METEOROLOGICAL AND SOUND).
K--COMPUTING.
L--SEARCHLIGHT CONTROL (INACTIVATED, USE G).
M--MAINTENANCE AND TEST ASSEMBLIES (INCLUDING TOOLS).
N--NAVIGATIONAL AIDS (INCLUDING ALTIMETERS, BEACONS, COMPASSES, RACONS, DEPTH SOUNDING, APPROACH, AND LANDING).

P--REPRODUCING (INACTIVATED, DO NOT USE).
Q--SPECIAL, OR COMBINATION OF PURPOSES.
R--RECEIVING, PASSIVE DETECTING.
S--DETECTING AND/OR RANGE AND BEARING, SEARCH.
T--TRANSMITTING.
W--AUTOMATIC FLIGHT OR REMOTE CONTROL.
X--IDENTIFICATION AND RECOGNITION.

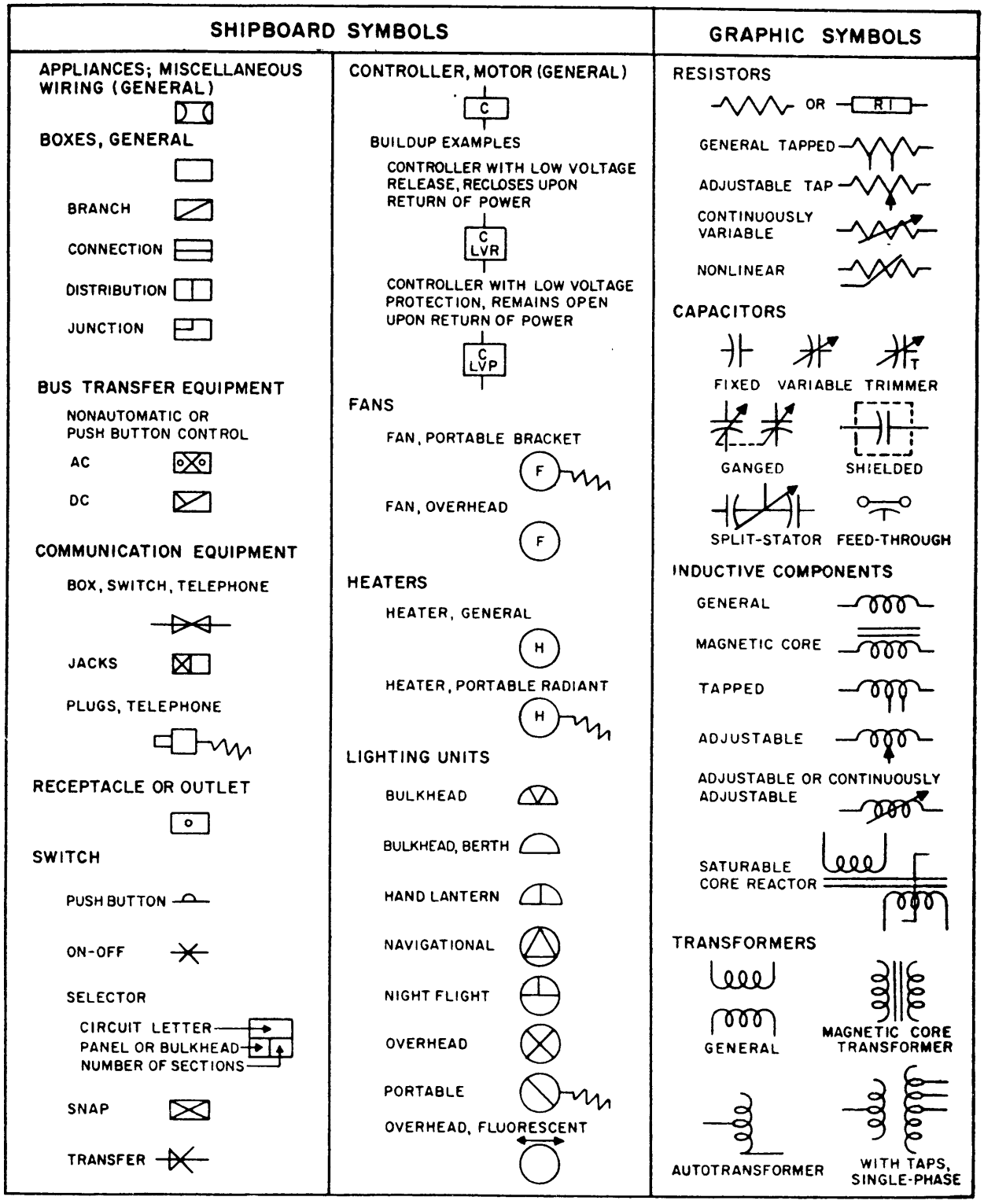
[1]NOT FOR US USE EXCEPT FOR ASSIGNING SUFFIX LETTERS TO PREVIOUSLY NOMENCLATURED ITEMS.

20.484

Figure A2-1.—AN system.

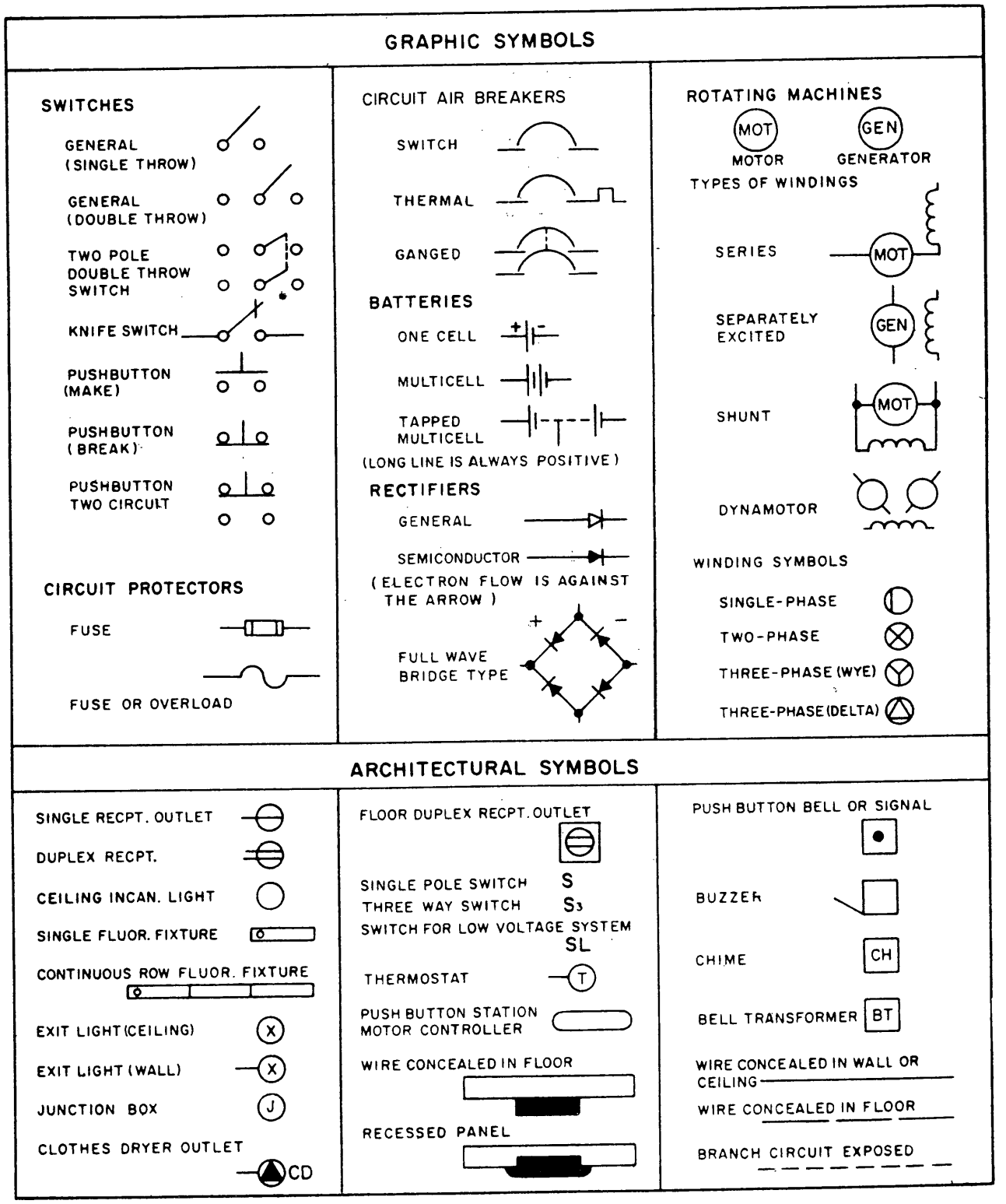
APPENDIX III

ELECTRICAL SYMBOLS



13.5(65C)

Figure A3-1.–Electrical Symbols.



13.5(65C)

Figure A3-2.—Electrical Symbols—Continued.

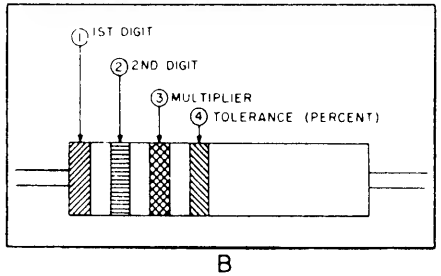
APPENDIX IV

ELECTRONICS COLOR CODING

65C)

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLERANCE (Percent)
Black	0	0	1	
Brown	1	1	10	
Red	2	2	100	
Orange	3	3	1,000	
Yellow	4	4	10,000	
Green	5	5	100,000	
Blue	6	6	1,000,000	
Violet	7	7	10,000,000	
Gray	8	8	100,000,000	
White	9	9	1,000,000,000	
Gold			.1	5
Silver			.01	10
No color				20

A



B

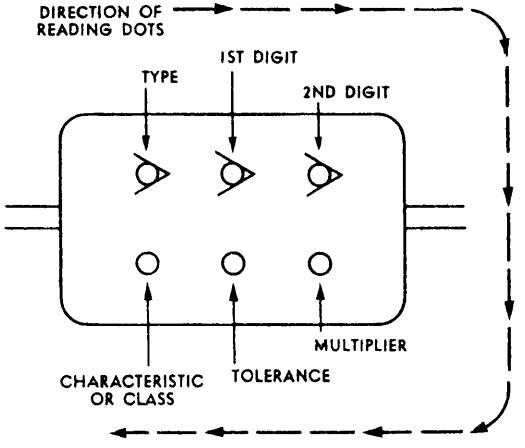
RESISTORS FOR MILITARY USE MAY HAVE A FIFTH BAND TO INDICATE RELIABILITY IN TERMS OF FAILURE RATE, AS FOLLOWS:

No Color: no test made
Brown : 1.0 percent per 100 hours
Red : 0.1 percent per 100 hours
Orange : 0.01 percent per 100 hours
Yellow : 0.001 percent per 100 hours

C

20.373:.374

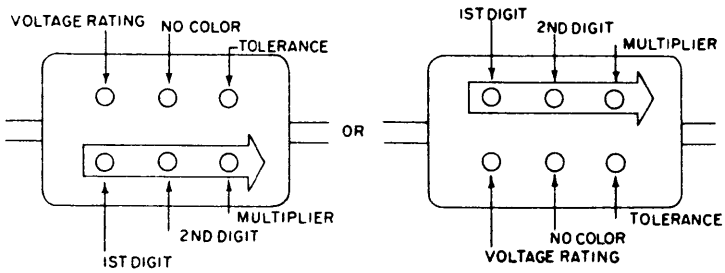
Figure A4-1.—Resistor color code.



TYPE	COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLERANCE (PERCENT)	CHARACTERISTIC OR CLASS
JAN, MICA	BLACK	0	0	1.0		APPLIES TO
	BROWN	1	1	10	± 1	TEMPERATURE
	RED	2	2	100	± 2	COEFFICIENT
	ORANGE	3	3	1,000	± 3	OR METHODS
	YELLOW	4	4	10,000	± 4	OF TESTING
	GREEN	5	5	100,000	± 5	
	BLUE	6	6	1,000,000	± 6	
	VIOLET	7	7	10,000,000	± 7	
	GRAY	8	8	100,000,000	± 8	
EIA, MICA	WHITE	9	9	1,000,000,000	± 9	
	GOLD			.1		
MOLDED PAPER	SILVER			.01	±10	
	BODY				±20	

20.376

Figure A4-2.—6-Dot color code for mica and molded paper capacitors.

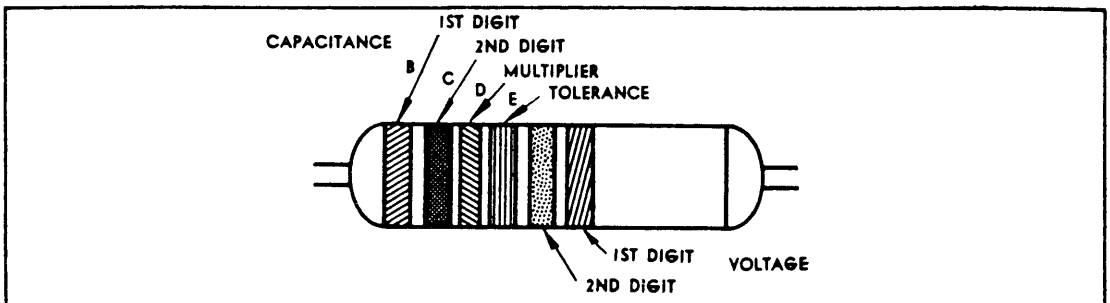


COLOR	1 ST DIGIT	2ND DIGIT	MULTIPLIER	TOLERANCE (PERCENT)	VOLTAGE RATING
BLACK	0	0	1.0		
BROWN	1	1	10	±1	100
RED	2	2	100	±2	200
ORANGE	3	3	1,000	±3	300
YELLOW	4	4	10,000	±4	400
GREEN	5	5	100,000	±5	500
BLUE	6	6	1,000,000	±6	600
VIOLET	7	7	10,000,000	±7	700
GRAY	8	8	100,000,000	±8	800
WHITE	9	9	1,000,000,000	±9	900
GOLD			.1		1000
SILVER			.01	±10	2000
BODY				±20	*

* WHERE NO COLOR IS INDICATED, THE VOLTAGE RATING MAY BE AS LOW AS 300 VOLTS.

Figure A4-3.—5-Dot color code for capacitors (dielectric not specified). 20.486

Figure A4-2.—6-Dot color code for mica and molded paper capacitors.

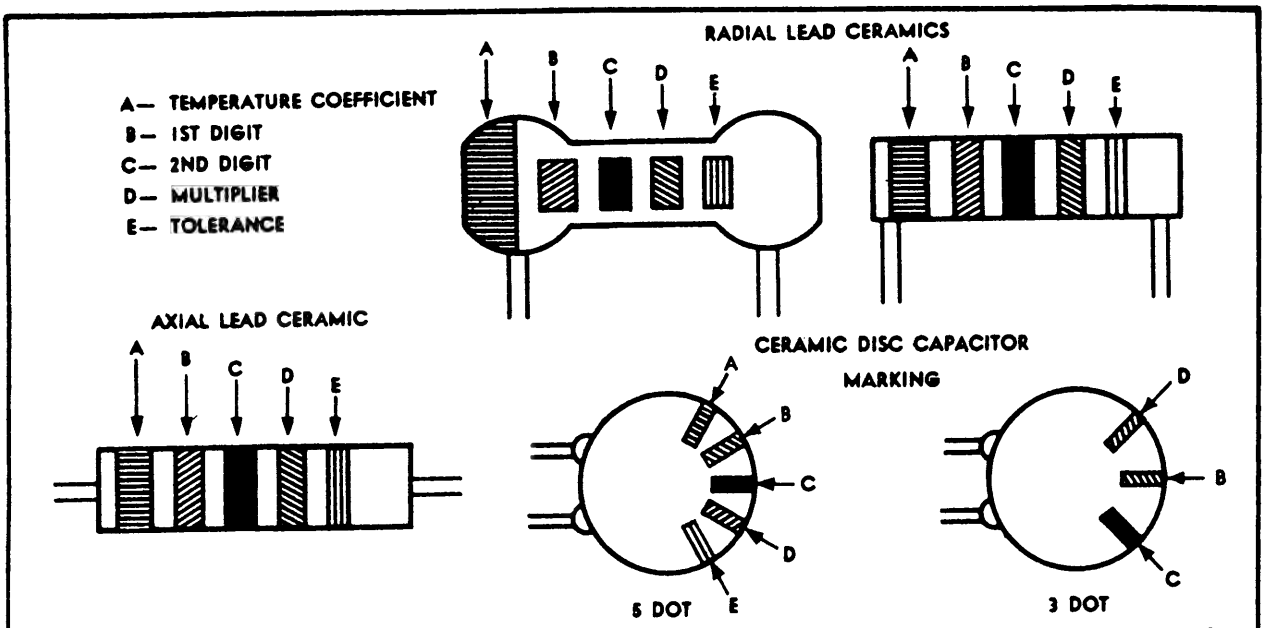


COLOR	CAPACITANCE			TOLERANCE (PERCENT)	VOLTAGE RATING	
	1ST DIGIT	2ND DIGIT	MULTIPLIER		1ST DIGIT	2ND DIGIT
BLACK	0	0	1	±20	0	0
BROWN	1	1	10		1	1
RED	2	2	100		2	2
ORANGE	3	3	1,000	±30	3	3
YELLOW	4	4	10,000	±40	4	4
GREEN	5	5	100,000	± 5	5	5
BLUE	6	6	1,000,000		6	6
VIOLET	7	7			7	7
GRAY	8	8			8	8
WHITE	9	9		±10	9	9

20.487

Figure A4-4.—6-Band color code for tubular paper dielectric capacitors.

Figure A4-1.—Resistor color code.

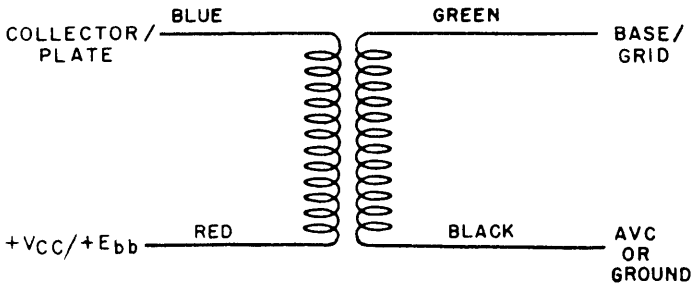


COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLERANCE		TEMPERATURE COEFFICIENT *
				MORE THAN 10 pf (IN PERCENT)	LESS THAN 10 pf (IN pf)	
BLACK	0	0	1.0	±20	±2.0	0
BROWN	1	1	10	± 1		—30
RED	2	2	100	± 2		—80
ORANGE	3	3	1,000			—150
YELLOW	4	4	10,000			—220
REEN	5	5		± 5	±0.5	—330
BLUE	6	6				—470
VIOLET	7	7				—750
GRAY	8	8	.01		±0.25	+30
WHITE	9	9	.1	±10	±1.0	+120 TO —750 (EIA)
						+500 TO —330 (JAN)
SILVER						+100 (JAN)
GOLD						BYPASS OR COUPLING (EIA)

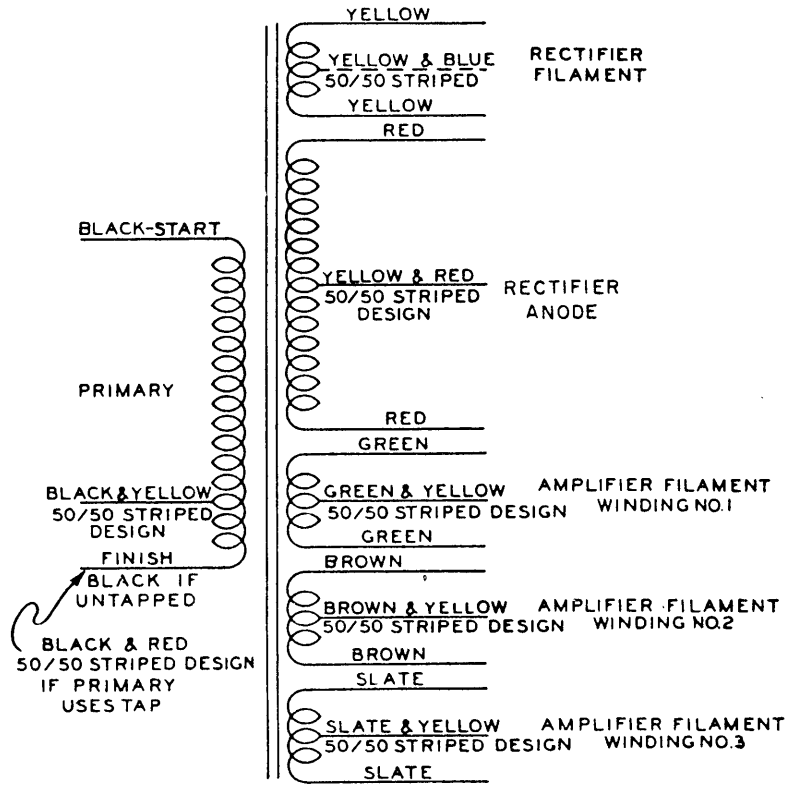
* PARTS PER MILLION PER DEGREE CELCIUS.

20.488

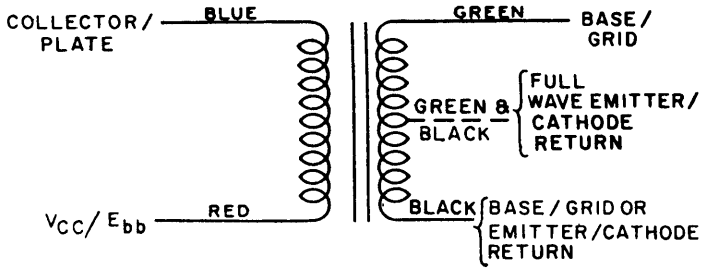
Figure A4-5.—Color code for ceramic capacitors having different configurations.



IF TRANSFORMERS.



POWER TRANSFORMERS.



INTERSTAGE AUDIO TRANSFORMERS

STANDARD COLORS USED IN CHASSIS WIRING FOR THE PURPOSE OF CIRCUIT IDENTIFICATION OF THE EQUIPMENT ARE AS FOLLOWS:

CIRCUIT	COLOR
GROUNDS, GROUNDED ELEMENTS, AND RETURNS	BLACK.
HEATERS OR FILAMENTS, OFF GROUND	BROWN.
POWER SUPPLY $+V_{cc}/+E_{bb}$	RED.
SCREEN GRIDS	ORANGE.
EMITTERS/CATHODES	YELLOW.
BASES/CONTROL GRIDS	GREEN.
COLLECTORS/ PLATES	BLUE
POWER SUPPLY, MINUS	VIOLET (PURPLE).
A.C. POWER LINES	GRAY.
MISCELLANEOUS, ABOVE OR BELOW GROUND RETURNS, AVC, ETC	WHITE.

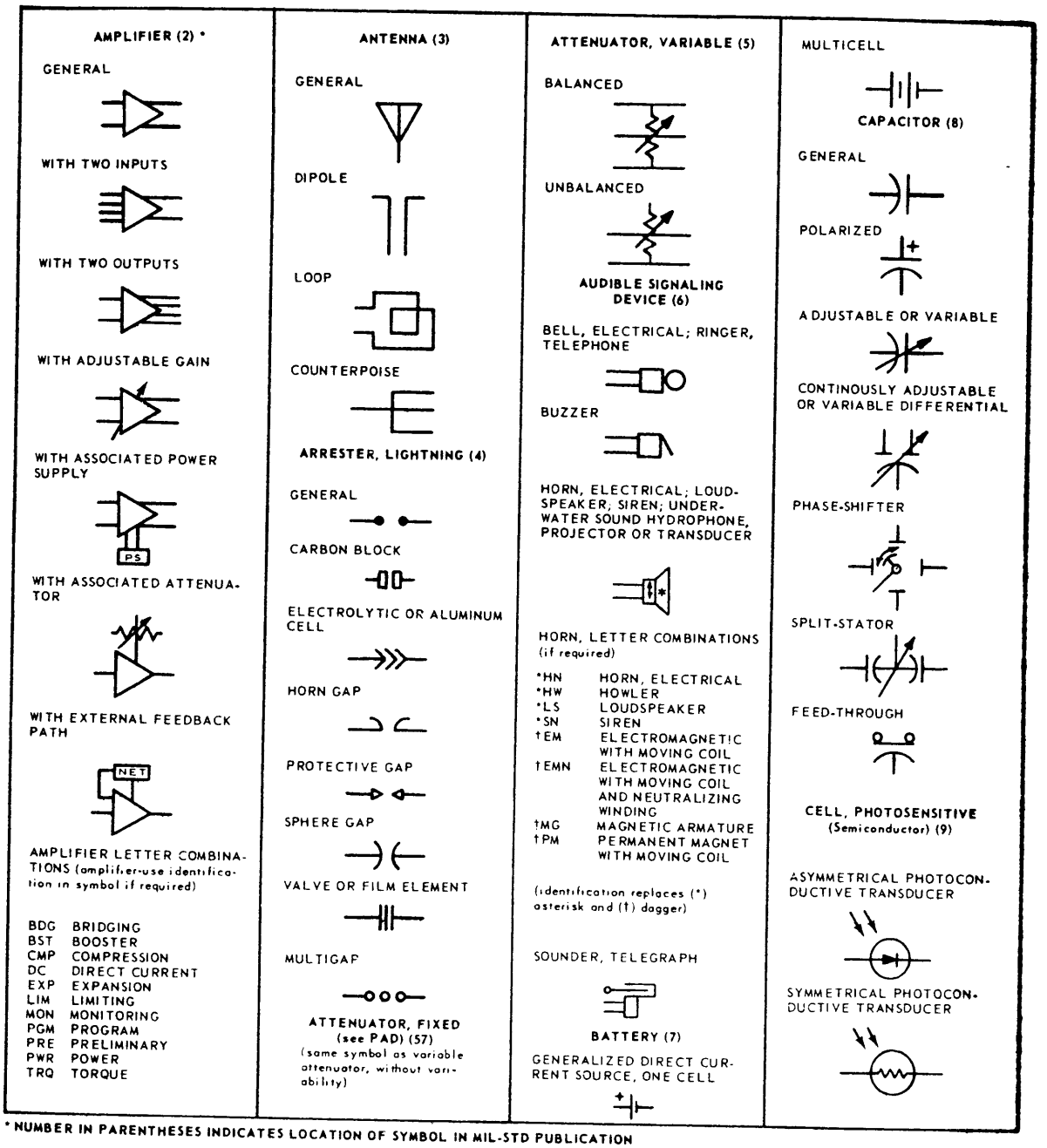
FOR OTHER ELECTRICAL AND ELECTRONIC SYMBOLS REFER TO MILITARY STANDARD, MIL-STD-15-1A

20.378:380

Figure A4-6.—Color code for transformers.

APPENDIX V

ELECTRONICS SYMBOLS

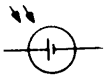


* NUMBER IN PARENTHESES INDICATES LOCATION OF SYMBOL IN MIL-STD PUBLICATION

13.5(179)A

Figure A5-1.—Electronics symbols.

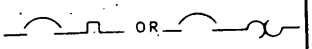
PHOTOVOLTAIC TRANSDUCER; SOLAR CELL



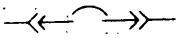
CIRCUIT BREAKER (11)

GENERAL

WITH MAGNETIC OVERLOAD



DRAWOUT TYPE



CIRCUIT ELEMENT (12)

GENERAL

CIRCUIT ELEMENT LETTER COMBINATIONS (replaces (*) asterisk)

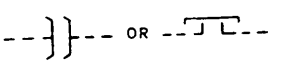
EG	EQUALIZER
FAX	FACSIMILE SET
FL	FILTER
FL-BE	FILTER, BAND ELIMINATION
FL-BP	FILTER, BAND PASS
FL-HP	FILTER, HIGH PASS
FL-LP	FILTER, LOW PASS
PS	POWER SUPPLY
RG	RECORDING UNIT
RU	REPRODUCING UNIT
DIAL	TELEPHONE DIAL
TEL	TELEPHONE STATION
TPR	TELEPRINTER
TTY	TELETYPEWRITER

ADDITIONAL LETTER COMBINATIONS (symbols preferred)

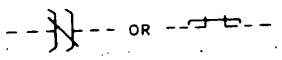
AR	AMPLIFIER
AT	ATTENUATOR
C	CAPACITOR
CB	CIRCUIT BREAKER
HS	HANDSET
I	INDICATING OR SWITCH BOARD LAMP
L	INDUCTOR
J	JACK
LS	LOUDSPEAKER
MIC	MICROPHONE
OSC	OSCILLATOR
PAD	PAD
P	PLUG
HT	RECEIVER, HEADSET
K	RELAY
R	RESISTOR
S	SWITCH OR KEY SWITCH
T	TRANSFORMER
WR	WALL RECEPTACLE

CLUTCH; BRAKE (14)

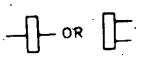
DISENGAGED WHEN OPERATING MEANS IS DE-ENERGIZED



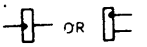
ENGAGED WHEN OPERATING MEANS IS DE-ENERGIZED



COIL, REPLAY and OPERATING (16)

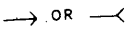


SEMICIRCULAR DOT INDICATES INNER END OF WIRING

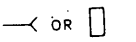


CONNECTOR (18)

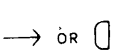
ASSEMBLY, MOVABLE OR STATIONARY PORTION; JACK, PLUG, OR RECEPTACLE



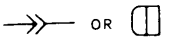
JACK OR RECEPTACLE



PLUG



SEPARABLE CONNECTORS



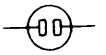
TWO-CONDUCTOR SWITCHBOARD JACK

TWO-CONDUCTOR SWITCHBOARD PLUG

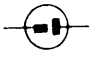
JACKS NORMALLED THROUGH ONE WAY

JACKS NORMALLED THROUGH BOTH WAYS

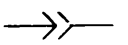
2-CONDUCTOR NONPOLARIZED, FEMALE CONTACTS



2-CONDUCTOR POLARIZED, MALE CONTACTS



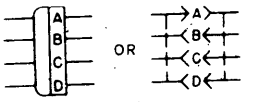
WAVEGUIDE FLANGE



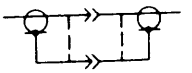
PLAIN, RECTANGULAR

CHOKE, RECTANGULAR

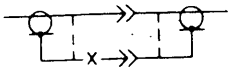
ENGAGED 4-CONDUCTOR; THE PLUG HAS 1 MALE AND 3 FEMALE CONTACTS, INDIVIDUAL CONTACT DESIGNATIONS SHOWN



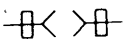
COAXIAL, OUTSIDE CONDUCTOR SHOWN CARRIED THROUGH



COAXIAL, CENTER CONDUCTOR SHOWN CARRIED THROUGH; OUTSIDE CONDUCTOR NOT CARRIED THROUGH



MATED CHOCK FLANGES IN RECTANGULAR WAVEGUIDE



COUNTER, ELECTROMAGNETIC; MESSAGE REGISTER (26)

GENERAL

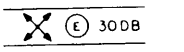
WITH A MAKE CONTACT

COUPLER, DIRECTIONAL (27)

(common coaxial/waveguide usage)

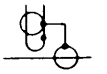
(common coaxial/waveguide usage)

E-PLANE APERTURE-COUPLING, 30-DECIBEL TRANSMISSION LOSS



COUPLING (28)

BY LOOP FROM COAXIAL TO CIRCULAR WAVEGUIDE, DIRECT-CURRENT GROUNDS CONNECTED

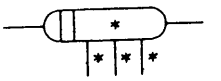


CRYSTAL, PIEZOELECTRIC (62)

DELAY LINE (31)

GENERAL

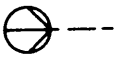
TAPPED DELAY



BIFILAR SLOW-WAVE STRUCTURE (commonly used in traveling-wave tubes)

(length of delay indication replaces (*) asterisk)

DETECTOR, PRIMARY; MEASURING TRANSDUCER (30) (see HALL GENERATOR and THERMAL CONVERTER)



DISCONTINUITY (33)

(common coaxial/waveguide usage)

EQUIVALENT SERIES ELEMENT, GENERAL

CAPACITIVE REACTANCE

INDUCTIVE REACTANCE

INDUCTANCE-CAPACITANCE CIRCUIT, INFINITE REACTANCE AT RESONANCE

13.5(179)B

Figure A5-2.—Electronics symbols—Continued.

INDUCTANCE-CAPACITANCE CIRCUIT, ZERO REACTANCE AT RESONANCE

RESISTANCE

EQUIVALENT SHUNT ELEMENT, GENERAL

CAPACITIVE SUSCEPTANCE

CONDUCTANCE

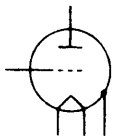
INDUCTIVE SUSCEPTANCE

INDUCTANCE-CAPACITANCE CIRCUIT, INFINITE SUSCEPTANCE AT RESONANCE

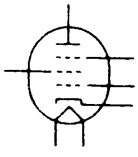
INDUCTANCE-CAPACITANCE CIRCUIT, ZERO SUSCEPTANCE AT RESONANCE

ELECTRON TUBE (34)

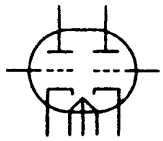
TRIODE



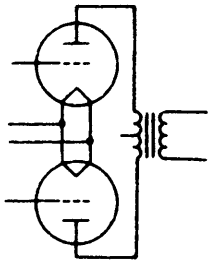
PENTODE, ENVELOPE CONNECTED TO BASE TERMINAL



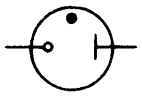
TWIN TRIODE, EQUIPOTENTIAL CATHODE



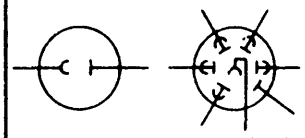
TYPICAL WIRING FIGURE TO SHOW TUBE SYMBOLS PLACED IN ANY CONVENIENT POSITION



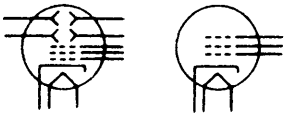
RECTIFIER; VOLTAGE REGULATOR
(see LAMP, GLOW)



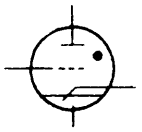
PHOTOTUBE, SINGLE AND MULTIPLIER



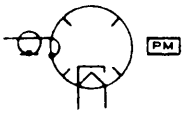
CATHODE-RAY TUBE, ELECTROSTATIC AND MAGNETIC DEFLECTION



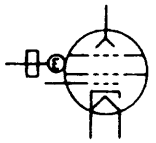
MERCURY-POOL TUBE, IGNITOR AND CONTROL GRID (see RECTIFIER)



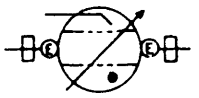
RESONANT MAGNETRON, COAXIAL OUTPUT AND PERMANENT MAGNET



REFLEX KLYSTRON, INTEGRAL CAVITY, APERTURE COUPLED

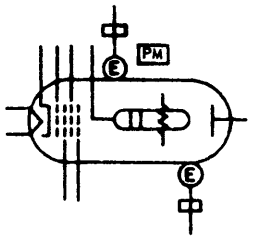


TRANSMIT-RECEIVE (TR) TUBE GAS FILLED, TUNABLE INTEGRAL CAVITY, APERTURE COUPLED, WITH STARTER



TRAVELING-WAVE TUBE (typical)

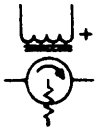
FORWARD-WAVE TRAVELING-WAVE-TUBE AMPLIFIER SHOWN WITH FOUR GRIDS, HAVING SLOW-WAVE STRUCTURE WITH ATTENUATION, MAGNETIC FOCUSING BY EXTERNAL PERMANENT MAGNET, *rf* INPUT AND *rf* OUTPUT COUPLING EACH E-PLANE APERTURE TO EXTERNAL RECTANGULAR



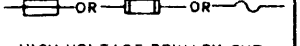
FERRITE DEVICES (100)

FIELD POLARIZATION ROTATOR

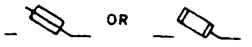
FIELD POLARIZATION AMPLITUDE MODULATOR



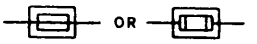
FUSE (36)



HIGH-VOLTAGE PRIMARY CUTOUT, DRY



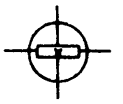
HIGH-VOLTAGE PRIMARY CUTOUT, OIL



GOVERNOR (contact-making) (37)

CONTACTS SHOWN HERE AS CLOSED

HALL GENERATOR (39)



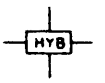
HANDSET (40)

GENERAL

OPERATOR'S SET WITH PUSH-TO-TALK SWITCH

HYBRID (41)

GENERAL

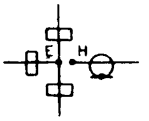


JUNCTION
(common coaxial/waveguide usage)

CIRCULAR

(E, H or HE transverse field indicators replace (*) asterisk)

RECTANGULAR WAVEGUIDE AND COAXIAL COUPLING



INDUCTOR (42)

GENERAL

(179)B

13.5(179)C

Figure A5-3.—Electronics symbols—Continued.

MAGNETIC CORE

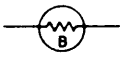
TAPPED

ADJUSTABLE, CONTINUOUSLY ADJUSTABLE

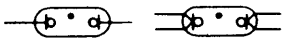
KEY, TELEGRAPH (43)

LAMP (44)

BALLAST LAMP; BALLAST TUBE

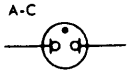


LAMP, FLUORESCENT, 2 AND 4 TERMINAL



LAMP, GLOW; NEON LAMP

A-C



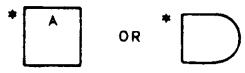
D-C

LAMP, INCANDESCENT

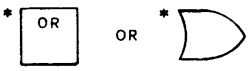
INDICATING LAMP; SWITCHBOARD LAMP
(see VISUAL SIGNALING DEVICE)

LOGIC (see 806B and Y32-14)
(including some duplicate symbols; left and right-hand symbols are not mixed)

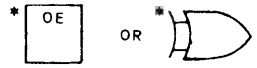
AND function



OR function



EXCLUSIVE-OR function



((*) input side of logic symbols in general)

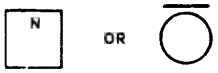
CONDITION INDICATORS

STATE (logic negation)

A LOGIC NEGATION OUTPUT BECOMES 1-STATE IF AND ONLY IF THE INPUT IS NOT 1-STATE

AN AND FUNC. WHERE OUTPUT IS LOW IF AND ONLY IF ALL INPUTS ARE HIGH

ELECTRIC INVERTER



(elec. invtr. output becomes 1-state if and only if the input is 1-state)
(elec. invtr. output is more pos. if and only if input is less pos.)

LEVEL (relative)

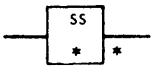
1-STATE IS LESS +

1-STATE IS MORE +

(symbol is a rt. triangle pointing in direction of flow)

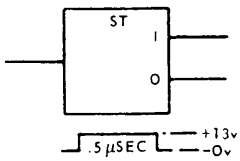
AN AND FUNC. WITH INPUT 1-STATES AT MORE POS. LEVEL AND OUTPUT 1-STATE AT LESS POS. LEVEL

SINGLE SHOT (one output)

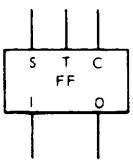


(waveform data replaces inside/outside (*))

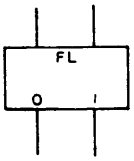
SCHMITT TRIGGER, WAVEFORM AND TWO OUTPUTS



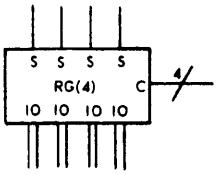
FLIP-FLOP, COMPLEMENTARY



FLIP-FLOP, LATCH

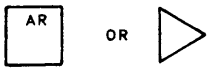


REGISTER



(binary register denoting four flip-flops and bits)

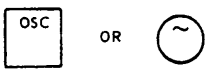
AMPLIFIER (see AMPLIFIER)



CHANNEL PATH(s) (see PATH, TRANSMISSION)

MAGNETIC HEADS (see PICK-UP HEAD)

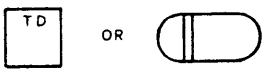
OSCILLATOR (see OSCILLATOR)



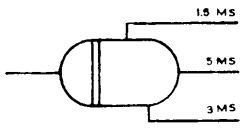
RELAY, CONTACTS (see CONTACT, ELECTRICAL) RELAY, ELECTROMAGNETIC (see RELAY COIL RECOGNITION

SIGNAL FLOW (see DIRECTION OF FLOW)

TIME DELAY (see DELAY LINE)



TIME DELAY WITH TYPICAL DELAY TAPS:



FUNCTIONS NOT OTHERWISE SYMBOLIZED

(identification replaces (*))

LOGIC LETTER COMBINATIONS

S	SET
C	CLEAR (reset)
T	TOGGLE (trigger)
(N)	NUMBER OF BITS
BO	BLOCKING OSCILLATOR
CF	CATHODE FOLLOWER
EF	EMITTER FOLLOWER
FF	FLIP-FLOP
SS	SINGLE SHOT
ST	SCHMITT TRIGGER
RG(N)	REGISTER (N stages)
SR	SHIFT REGISTER

MACHINE, ROTATING (46)

GENERATOR

MOTOR

METER, INSTRUMENT (48)

(identification replaces (*) asterisk)

METER LETTER COMBINATIONS

A	AMMETER
AH	AMPERE-HOUR
CMA	CONTACT-MAKING (or breaking) AMMETER
CMC	CONTACT-MAKING (or breaking) CLOCK
CMV	CONTACT-MAKING (or breaking) VOLTMETER
CRO	OSCILLOSCOPE OR CATHODE-RAY OSCILLOGRAPH
DB	DB (decibel) METER
DBM	DBM (decibels referred to 1 milliwatt) METER
DM	DEMAND METER
DTR	DEMAND-TOTALIZING RELAY
F	FREQUENCY METER
G	GALVANOMETER
GD	GROUND DETECTOR
I	INDICATING
INT	INTEGRATING
μA or UA	MICROAMMETER
MA	MILLIAMMETER
NM	NOISE METER
OHM	OHMMETER
OP	OIL PRESSURE

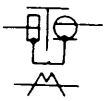
13.5(179)D

Figure A5-4.—Electronics symbols—Continued.

MODE TRANSDUCER (53)

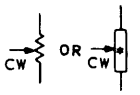
(common coaxial/waveguide usage)

TRANSDUCER FROM RECTANGULAR WAVEGUIDE TO COAXIAL WITH MODE SUPPRESSION, DIRECT-CURRENT GROUNDS CONNECTED



MOTION, MECHANICAL (54)

ROTATION APPLIED TO A RESISTOR

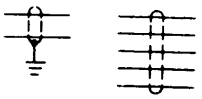


(identification replaces (*) asterisk)

NUCLEAR-RADIATION DETECTOR, GAS FILLED; IONIZATION CHAMBER; PROPROTIONAL COUNTER TUBE; GEIGER-MULLER COUNTER TUBE (50) (see RADIATION-SENSITIVITY INDICATOR)

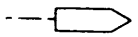
PATH, TRANSMISSION (58)

CABLE; 2-CONDUCTOR, SHIELD GROUNDED AND 5-CONDUCTOR SHIELDED

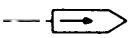


PICKUP HEAD (61)

GENERAL

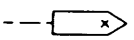


WRITING; RECORDING

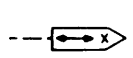


READING; PLAYBACK

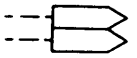
ERASING



WRITING, READING, AND ERASING



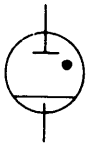
STEREO



RECTIFIER (65)

SEMICONDUCTOR DIODE; METALLIC RECTIFIER; ELECTROLYTIC RECTIFIER; ASYMMETRICAL VARISTOR

MERCURY-POOL TUBE POWER RECTIFIER

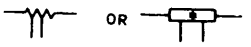


FULLWAVE BRIDGE-TYPE

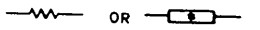
RESISTOR (68)

GENERAL

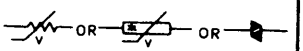
TAPPED



HEATING

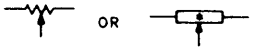


SYMMETRICAL VARISTOR RESISTOR, VOLTAGE SENSITIVE (silicon carbide, etc.)

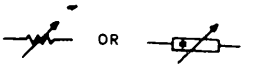


(identification marks replace (*) asterisk)

WITH ADJUSTABLE CONTACT



ADJUSTABLE OR CONTINUOUSLY ADJUSTABLE (variable)

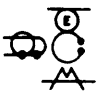


(identification replaces (*) asterisk)

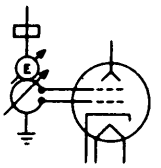
RESONATOR, TUNED CAVITY (71)

(common coaxial/waveguide usage)

RESONATOR WITH MODE SUPPRESSION COUPLED BY AN E-PLANE APERTURE TO A GUIDED TRANSMISSION PATH AND BY A LOOP TO A COAXIAL PATH



TUNABLE RESONATOR WITH DIRECT-CURRENT GROUND CONNECTED TO AN ELECTRON DEVICE AND ADJUSTABLY COUPLED BY AN E-PLANE APERTURE TO A RECTANGULAR WAVEGUIDE



ROTARY JOINT, RF (COUPLER) (72)

GENERAL; WITH RECTANGULAR WAVEGUIDE

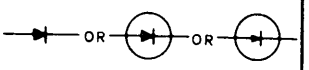
(transmission path recognition symbol replaces (*) asterisk)

COAXIAL TYPE IN RECTANGULAR WAVEGUIDE

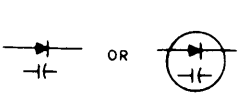
CIRCULAR WAVEGUIDE TYPE IN RECTANGULAR WAVEGUIDE

SEMICONDUCTOR DEVICE (73)
(Two Terminal, diode)

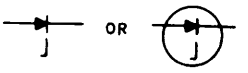
SEMICONDUCTOR DIODE; RECTIFIER



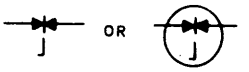
CAPACITIVE DIODE (also Varicap, Varactor, reactance diode, parametric diode)



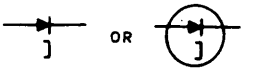
BREAKDOWN, DIODE, UNIDIRECTIONAL (also backward diode, avalanche diode, voltage regulator diode, Zener diode, voltage reference diode)



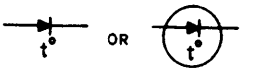
BREAKDOWN DIODE, BIDIRECTIONAL AND BACKWARD DIODE (also bipolar voltage limiter)



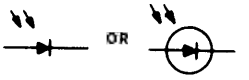
TUNNEL DIODE (also Esaki diode)



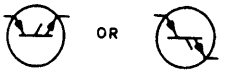
TEMPERATURE-DEPENDENT DIODE

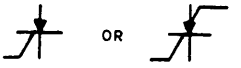


PHOTODIODE (also solar cell)



SEMICONDUCTOR DIODE, PNPN SWITCH (also Shockley diode, four-layer diode and SCR).





(Multi-Terminal, transistor, etc.)

PNP TRANSISTOR

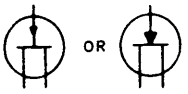
NPN TRANSISTOR

UNIJUNCTION TRANSISTOR, N-TYPE BASE

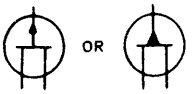
Figure A5-5.–Electronics symbols–Continued.

UNIJUNCTION TRANSISTOR, P-TYPE BASE

FIELD-EFFECT TRANSISTOR, N-TYPE BASE



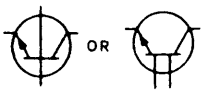
FIELD-EFFECT TRANSISTOR, P-TYPE BASE



SEMICONDUCTOR TRIODE, PNPN-TYPE SWITCH

SEMICONDUCTOR TRIODE, NPNP-TYPE SWITCH

NPN TRANSISTOR, TRANSVERSE-BIASED BASE



PNIP TRANSISTOR, OHMIC CONNECTION TO THE INTRINSIC REGION

NPIN TRANSISTOR, OHMIC CONNECTION TO THE INTRINSIC REGION

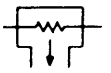
PNIN TRANSISTOR, OHMIC CONNECTION TO THE INTRINSIC REGION

NPIP TRANSISTOR, OHMIC CONNECTION TO THE INTRINSIC REGION

SQUIB (75)

EXPLOSIVE

IGNITER



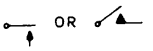
SENSING LINK; FUSIBLE LINK OPERATED

SWITCH (76)

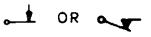
PUSH BUTTON, CIRCUIT CLOSING (make)

PUSH BUTTON, CIRCUIT OPENING (break)

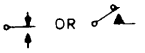
NONLOCKING, MOMENTARY CIRCUIT CLOSING (make)



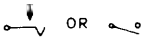
NONLOCKING; MOMENTARY CIRCUIT OPENING (break)



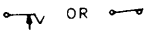
TRANSFER



LOCKING, CIRCUIT CLOSING (make)



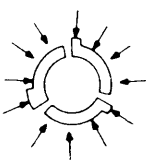
LOCKING, CIRCUIT OPENING (break)



TRANSFER, 3-POSITION

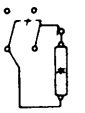
WAFER

(example shown: 3-pole 3-circuit with 2 nonshorting and 1 shorting moving contacts)



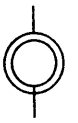
SAFETY INTERLOCK, CIRCUIT OPENING AND CLOSING

2-POLE FIELD-DISCHARGE KNIFE, WITH TERMINALS AND DISCHARGE RESISTOR



(identification replaces (*) asterisk)

SYNCHRO (78)

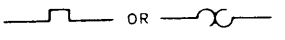


SYNCHRO LETTER COMBINATIONS

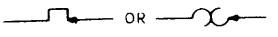
CDX	CONTROL-DIFFERENTIAL TRANSMITTER
CT	CONTROL TRANSFORMER
CX	CONTROL TRANSMITTER
TDR	TORQUE-DIFFERENTIAL RECEIVER
TDX	TORQUE-DIFFERENTIAL TRANSMITTER
TR	TORQUE RECEIVER
TX	TORQUE TRANSMITTER
RS	RESOLVER
B	OUTER WINDING ROTATABLE IN BEARINGS

THERMAL ELEMENT (83)

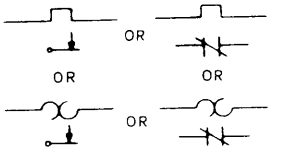
ACTUATING DEVICE



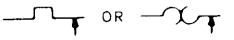
THERMAL CUTOUT, FLASHER



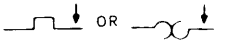
THERMAL RELAY



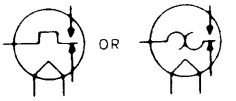
THERMOSTAT (operates on rising temperature), CONTACT



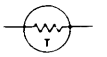
THERMOSTAT, MAKE CONTACT



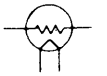
THERMOSTAT, INTEGRAL HEATER AND TRANSFER CONTACTS



THERMISTOR; THERMAL RESISTOR (84)



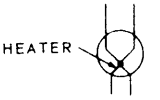
WITH INTEGRAL HEATER



THERMOCOUPLE (85)

TEMPERATURE-MEASURING

CURRENT-MEASURING, INTEGRAL HEATER CONNECTED



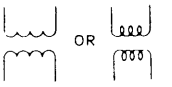
CURRENT-MEASURING, INTEGRAL HEATER INSULATED

TEMPERATURE-MEASURING, SEMICONDUCTOR

CURRENT-MEASURING, SEMICONDUCTOR

TRANSFORMER (86)

GENERAL



MAGNETIC-CORE

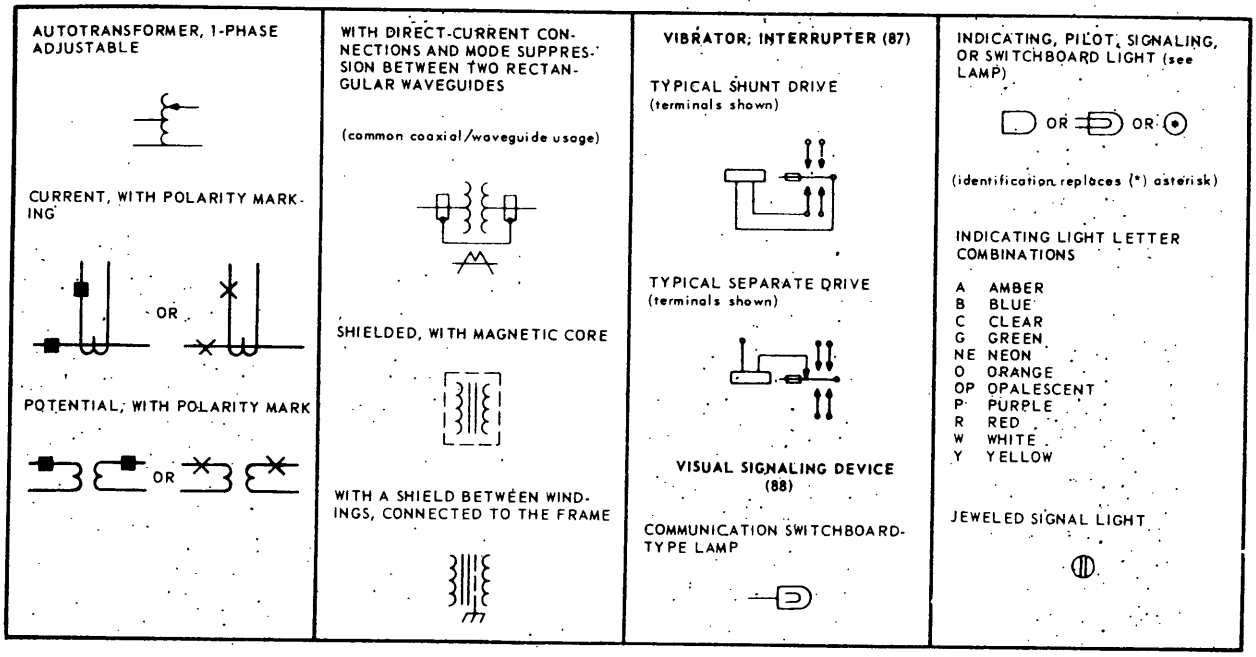
ONE WINDING WITH ADJUSTABLE INDUCTANCE

SEPARATELY ADJUSTABLE INDUCTANCE

ADJUSTABLE MUTUAL INDUCTOR, CONSTANT-CURRENT

13.5(179)F

Figure A5-6.—Electronics symbols—Continued.



13.5(179)G

Figure A5-7.—Electronics symbols—Continued.

APPENDIX VI

GREEK ALPHABET

Table A6-1.–Greek Alphabet

Name	Capital	Lower case	Designates
Alpha	A	α	Angles.
Beta.	B	β	Angles, flux density.
Gamma.	Γ	γ	Conductivity.
Delta	Δ	δ	Variation of a quantity, increment.
Epsilon.	E	ϵ	Base of natural logarithms (2.71828).
Zeta.	Z	ζ	Impedance, coefficients, coordinates.
Eta	H	η	Hysteresis coefficient, efficiency.
Theta	Θ	θ	Phase angle.
Iota	I	ι	
Kappa.	K	κ	Dielectric constant, coupling coefficient, susceptibility.
Lambda	Λ	λ	Wavelength.
Mu.	M	μ	Permeability, micro, amplification factor.
Nu	N	ν	Reluctivity.
Xi	Ξ	ξ	
Omicon.	O	o	
Pi	Π	π	3.1416
Rho	P	ρ	Resistivity.
Sigma.	Σ	σ	Summation, standard deviation.
Tau	T	τ	Time constant, time-phase displacement.
Upsilon.	Υ	υ	
Phi	Φ	ϕ	Angles, magnetic flux.
Chi	X	χ	
Psi	Ψ	ψ	Dielectric flux, phase difference.
Omega	Ω	ω	Ohms (capital), angular velocity ($2 \pi f$).

APPENDIX VII

FORMULAS

Ohm's Law for D-C circuits

$$I = \frac{E}{R} = \frac{P}{E} = \sqrt{\frac{P}{R}}$$

$$R = \frac{E}{I} = \frac{P}{I^2} = \frac{E^2}{P}$$

$$E = IR = \frac{P}{I} = \sqrt{PR}$$

$$P = EI = \frac{E^2}{R} = I^2R$$

Resistors in Series

$$R_T = R_1 + R_2 \ldots$$

Resistors in Parallel

Two resistors

$$R_T = \frac{R_1 R_2}{R_1 + R_2}$$

More than two

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$$

Comparison of Units in Electric and Magnetic Circuits

	Electric circuit	Magnetic circuit
Force	Volt, E, or emf	Gilberts, F, or mmf.
Flow	Ampere, I	Flux, Φ, in maxwells.
Opposition	Ohms, R.	Reluctance, $\Re$.
Law	Ohms law, $I = \frac{E}{R}$	Rowland's law, $\Phi = \frac{F}{\Re}$.
Intensity of force	Volts per cm of length.	$H = \frac{1.257IN}{L}$, gilberts per centimeter of length.
Density	Current density—for example, amperes per cm^2.	Flux density—for example, lines per cm^2, or gausses.

R-L Circuit Time Constant equals

$$\frac{L \text{ (in henrys)}}{R \text{ (in ohms)}} = t \text{ (in seconds), or}$$

$$\frac{L \text{ (in microhenrys)}}{R \text{ (in ohms)}} = t \text{ (in microseconds)}$$

R-C Circuit Time Constants equals

R (ohms) × C (farads) = t (seconds)

R (megohms) × C (microfarads) = t (seconds)

R (ohms) × C (microfarads) = t (microseconds)

R (megohms) × C (micromicrofarads) = t (microseconds)

Capacitors in Series

Two capacitors

$$C_T = \frac{C_1 C_2}{C_1 + C_2}$$

More than two

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \ldots$$

Capacitors in Parallel $C_T = C_1 + C_2 \ldots$

Capacitive Reactance $\left(X_C = \frac{1}{2\pi fC}\right)$

Impedance in an R-C Circuit (Series)

$$Z = \sqrt{R^2 + X_C{}^2}$$

Figure A7-1.—Formulas.

Inductors in Series

$$L_T = L_1 + L_2 \ldots$$

(No coupling between coils)

Inductors in Parallel

Two inductors

$$L_T = \frac{L_1 L_2}{L_1 + L_2}$$

(No coupling between coils)

More than two

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} \ldots$$

(No coupling between coils)

Inductive Reactance

$$X_L = 2\pi fL$$

Q of a Coil

$$Q = \frac{X_L}{R}$$

Impedance of an R-L Circuit (Series)

$$Z = \sqrt{R^2 + X_L{}^2}$$

Impedance with R, C, and L in Series

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

Parallel Circuit Impedance

$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

Sine-Wave Voltage Relationships

Average value

$$E_{ave} = \frac{2}{\pi} \times E_{max} = 0.637E_{max}$$

Effective or r.m.s. value

$$E_{eff} = \frac{E_{max}}{\sqrt{2}} = \frac{E_{max}}{1.414} = 0.707E_{max} = 1.11E_{ave}$$

Maximum value

$$E_{max} = \sqrt{2}\ E_{eff} = 1.414E_{eff} = 1.57E_{ave}$$

Voltage in an a-c circuit

$$E = IZ = \frac{P}{I \times P.F.}$$

Current in an a-c circuit

$$I = \frac{E}{Z} = \frac{P}{E \times P.F.}$$

Power in A-C Circuit

Apparent power = EI

True power ($P = EI \cos \theta = EI \times P.F.$

Power Factor

$$P.F. = \frac{P}{EI} = \cos \theta$$

$$\cos \theta = \frac{\text{true power}}{\text{apparent power}}$$

Transformers

Voltage relationship

$$\frac{E_p}{E_s} = \frac{N_p}{N_s} \text{ or } E_s = E_p \times \frac{N_s}{N_p}$$

Current relationship

$$\frac{I_p}{I_s} = \frac{N_s}{N_p}$$

Induced voltage

$$E_{eff} = 4.44\ BAfN10^{-8}$$

Turns ratio equals

$$\frac{N_p}{N_s} = \sqrt{\frac{Z_p}{Z_s}}$$

Secondary current

$$I_s = I_p \cdot \frac{N_p}{N_s}$$

Secondary voltage

$$E_s = E_p \frac{N_s}{N_p}$$

Three-Phase Voltage and Current Relationships

With Wye connected windings

$$E_{line} = 1.732E_{coil} = \sqrt{3}\ E_{coil}$$

$$I_{line} = I_{coil}$$

With delta connected windings

$$E_{line} = E_{coil}$$

$$I_{line} = 1.732I_{coil}$$

Figure A7-2.—Formulas—Continued.

With wye or delta connected winding

$$P_{coil} = E_{coil}\, I_{coil}$$

$$P_t = 3P_{coil}$$

$$P_t = 1.732 E_{line}\, I_{line}$$

(To convert to true power multiply by $\cos\theta$)

Resonance

At resonance

$$X_L = X_C$$

Resonant frequency

$$F_o = \frac{1}{2\pi\sqrt{LC}}$$

Series resonance

$$Z \text{ (at any frequency)} = R + j(X_L - X_C)$$

$$Z \text{ (at resonance)} = R$$

Parallel resonance

$$A \text{ (at any frequency)} = \frac{Z_1 Z_2}{Z_1 + Z_2}$$

$$Z_{max} \text{ (at resonance)} = \frac{X_L X_C}{R} = \frac{X_L{}^2}{R} = QX_L = \frac{L}{CR}$$

Band width

$$\Delta = \frac{F_o}{Q} = \frac{R}{2\pi L}$$

Tube characteristics

Amplification factor

$$\mu = \frac{\Delta e_p}{\Delta e_g} \text{ (i_p constant)}$$

$$\mu = g_m r_p$$

A-c plate resistance

$$r_p = \frac{\Delta e_p}{\Delta i_p} \text{ (e_g constant)}$$

Grid-plate transconductance

$$g_m = \frac{\Delta i_p}{\Delta e_g} \text{ (e_p constant)}$$

Decibels

Power ratio

$$db = 10 \log_{10} \frac{P_2}{P_1}$$

Current and voltage ratio

$$db = 20 \log_{10} \frac{I_2\sqrt{R_2}}{I_1\sqrt{R_1}}$$

$$db = 20 \log_{10} \frac{E_2\sqrt{R_1}}{E_1\sqrt{R_2}}$$

NOTE: When R_1 and R_2 ar equal they may be omitted from the formula.

When reference level is one milliwatt

$$dbm = 10 \log_{10} \frac{P}{0.001} \text{ (when P is in watts)}$$

Synchronous Speed of Motor

$$r.p.m. = \frac{120 \times \text{frequency}}{\text{number of poles}}$$

Radar Power Relationships

$$\text{Duty cycle} = \frac{\text{average power}}{\text{peak power}} = \frac{\text{pulse width}}{\text{pulse repetition time}}$$

Average power = peak power × duty cycle

$$\text{Peak power} = \frac{\text{average power} \times 10^6}{\text{pulse width in } \mu\text{sec.} \times \text{PRF}}$$

Figure A7-3.—Formulas—Continued.

APPENDIX VIII

LAWS OF EXPONENTS

The following table shows some multiples of 10, their equivalent powers of ten, their prefixes, and their symbols which are used to write a number in scientific form.

Number	Powers of Ten	Prefix	Symbol
1,000,000,000,000 =	10^{12}	Tera	T
1,000,000,000 =	10^{9}	Giga	G
1,000,000 =	10^{6}	Mega	M
100,000 =	10^{5}		
10,000 =	10^{4}		
1,000 =	10^{3}	Kilo	k
100 =	10^{2}	Hecto	h
10 =	10^{1}	Deka	dk
1 =	10^{0}		
0.1 =	10^{-1}	Deci	d
0.01 =	10^{-2}	Centi	c
0.001 =	10^{-3}	Milli	m
0.0001 =	10^{-4}		
0.00001 =	10^{-5}		
0.000001 =	10^{-6}	Micro	μ
0.000000001 =	10^{-9}	Nano	n
0.000000000001 =	10	Pico	p

To multiply like (with same base) exponential quantities, add the exponents. In the language of algebra the rule is $a^m \times a^n = a^{m+n}$.

$$10^4 + 10^2 = 10^{4+2} = 10^6$$

$$0.003 \times 825.2 = 3 \times 10^{-3} \times 8.252 \times 10^2 =$$

$$24.756 \times 10^{-1} = 2.4756$$

To divide like exponential quantities, subtract the exponents. In the language of algebra the rule is

$$\frac{a^m}{a^n} = a^{m-n} \text{ or } 10^8 + 10^2 = 10^6$$

$$3,000 + 0.015 = (3 \times 10^3) + (1.5 \times 10^{-2}) =$$

$$2 \times 10^5 = 200,000$$

To raise an exponential quantity to a power, multiply the exponents. In the language of algebra $(x^m)^n = x^{m\,n}$.

$$(10^3)^4 = 10^{3 \times 4} = 10^{12}$$

$$2,500^2 = (2.5 \times 10^3) = 6.25 \times 10^6 =$$
$$6,250,000$$

Any number (except zero) raised to the zero power is one. In the language of algebra $x^0 = 1$

$$x^3 \div x^3 = 1$$
$$10^4 \div 10^4 = 1$$

Any base with a negative exponent is equal to 1 divided by the base with an equal positive exponent. In the language of algebra

$$x^{-a} = \frac{1}{x^a}$$

$$10^{-2} = \frac{1}{10^2} = \frac{1}{100}$$

$$5a^{-3} = \frac{5}{a^3}$$

$$(6a)^{-1} = \frac{1}{6a}$$

To raise a product to a power, raise each **factor of the** product to that power.

$$(2 \times 10)^2 = 2^2 \times 10^2$$

$$3,000^3 = (3 \times 10^3)^3 = 27 \times 10^9$$

To find the nth root of an exponential quantity, divide the exponent by the index of the root. Thus, with nth root of $a^m = a^{m/n}$.

$$\sqrt{x^6} = x^{6/2} = x$$

$$\sqrt[3]{64 \times 10^3} = 4 \times 10 = 40$$

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APPENDIX IX

THE METRIC SYSTEM

MEASURES OF LENGTH

Metric denominations and values		Equivalents in denominations in use	
Myriameter	10,000 meters	6.2137	miles.
Kilometer	1,000 meters	0.62137	mile, or 3,280 feet and 10 inches.
Hectometer	100 meters	328	feet and 1 inch.
Dekameter	10 meters	393.7	inches.
Meter	1 meter	39.37	inches.
Decimeter	1/10 of a meter	3.937	inches.
Centimeter	1/100 of a meter	0.3937	inch.
Millimeter	1/1000 of a meter	0.0394	inch.

MEASURES OF CAPACITY

Metric denominations and values			Equivalents in denominations in use	
Names	Number of liters	Cubic measure	Dry measure	Liquid or wine measure
Kiloliter or stere	1,000	1 cubic meter	1.308 cubic yards	264.17 gallons.
Hectoliter	100	1/10 of a cubic meter	2 bushels and 3.35 pecks	26.417 gallons.
Dekaliter	10	10 cubic decimeters	9.08 quarts	2.6417 gallons.
Liter	1	1 cubic decimeter	0.908 quart	1.0567 quarts.
Deciliter	1/10	1/10 of a cubic decimeter	6.1022 cubic inches	0.845 gill.
Centiliter	1/100	10 cubic centimeters	0.6102 cubic inch	0.338 fluid ounce.
Milliliter	1/1000	1 cubic centimeter	0.061 cubic inch	0.27 fluid dram.

MEASURES OF SURFACE

Metric denominations and values		Equivalents in denominations in use	
Hectare	10,000 square meters	2.471	acres.
Are	100 square meters	119.6	square yards.
Centare	1 square meter	1,550	square inches.

WEIGHTS

Metric denominations and values			Equivalents in denominations in use
Names	Number of grams	Weight of what quantity of water at maximum density	Avoirdupois weight
Millier or tonneau	1,000,000	1 cubic meter	2204.6 pounds.
Quintal	100,000	1 hectoliter	220.46 pounds.
Myriagram	10,000	10 liters	22.046 pounds.
Kilogram or kilo	1,000	1 liter	2.2046 pounds.
Hectogram	100	1 deciliter	3.5274 ounces.
Dekagram	10	10 cubic centimeters	0.3527 ounce.
Gram	1	1 cubic centimeter	15.432 grains.
Decigram	1/10	1/10 of a cubic centimeter	1.5432 grains.
Centigram	1/100	10 cubic millimeters	0.1543 grain.
Milligram	1/1000	1 cubic millimeter	0.0154 grain.

162.203

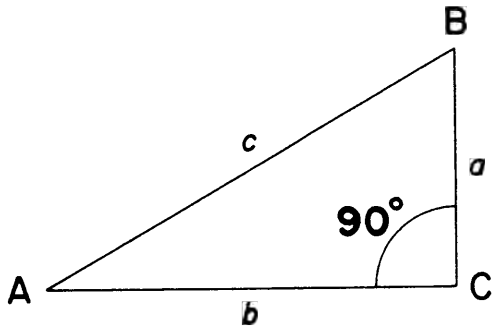
Figure A9-1.—The Metric System.

APPENDIX X

TRIGONOMETRY AND THE SLIDE RULE

TRIGONOMETRY AND THE SLIDE RULE

The following plane trigonometric formulas will be employed in the slide rule solutions of problems considered in this appendix. Referring to figure A10-1, the following definitions and relationships for the right triangle are given.



1.376

Figure A10-1.—Right triangle.

$$\text{Sine A} = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{a}{c},$$

$$\text{Cosine A} = \frac{\text{opposite side}}{\text{hypotenuse}} = \frac{b}{c},$$

$$\text{Tangent A} = \frac{\text{opposite side}}{\text{adjacent side}} = \frac{a}{b},$$

THE S (SINE) AND SRT (SINE, RADIAN, TANGENT) SCALES

The graduations on the sine scales S and SRT (sometimes labeled the ST Scale) represent angles. We shall speak of setting the slide rule hairline to an angle or drawing an angle under the hairline.

There are two S scales, one called the S or sine scale specified by the black numbers on S; the other S red or the cosine scale specified by the red numbers. The sine scale is the predominant scale. In the paragraphs that follow, any reference to an angle on a trigonometric scale will be to the angle in black unless otherwise indicated.

The scale designated SRT is, as its name indicates, used to find sines, radian equivalents, and tangents of angles, ranging from 0.573 degrees to 5.73 degrees approximately. In this appendix our interest is mainly in sines.

Each small inscription at the right of a scale is called the legend of the scale. A legend of a scale specifies a range of values associated with the function represented by the scale. Thus the legend 0.1 to 1.0 of scale S specifies that the sines of the angles on S and the cosines of angles on S red range from 0.1 to 1, and the legend 0.01 to 0.1 of the SRT scale indicates that sines (or radian equivalents and tangents) of angles on SRT range from 0.01 to 0.1.

Example. Evaluate (a) sin 30°.
(b) sin 2.86°.

Solution. (a) Opposite 30° on S, read on C scale (or D scale when rule is closed) 0.50. The result 0.50 lies between 0.1 and 1.0, that is, within the range specified by the legend 0.1 to 1.0 of S.

Solution. (b) Opposite 2.86° on SRT, read on C scale 0.05. The result 0.05 lies between 0.01 and 0.1, that is, within the range specified by the legend of 0.01 to 0.1 of SRT.

EXERCISES

Find the sine of each of the following angles.

(1) 32°	(4) 2.61°	(7) 3.34°	(10) 90°
(2) 64°	(5) 48.2°	(8) 56.3°	(11) 86.3°
(3) 1.86°	(6) 72°	(9) 4.81°	(12) 45°

Find the cosine of each of the angles in the above exercise. Use the red numbers on the S scale.

For angles greater than 84.26°, use cos A = sin (90° - A) on scale C. For example, set the hairline to 20° on S, at the hairline on C read

0.342 = sin 20° = cos 70°. Thus to find cosine 87.2°, write cosing 87.2° = sin 2.8° and set the hairline to 2.8° on SRT, at the hairline on C read 0.0488 = sin 2.8° = cos 87.2°.

Find x in each of the following equations:

(13) sin x = 0.5.
(14) sin x = 0.68.
(15) sin x = 0.485.
(16) sin x = 0.1.
(17) sin x = 0.16.
(18) sin x = 0.0366.

Find cos x in each of the above equations.

LAW OF SINES

In any triangle such as ABC of figure A10-1, A, B, and C represent the angles and a, b, and c, represent, respectively, the lengths of the sides opposite these angles. Thus, the following relations hold true.

Law of sines: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

Law of cosines: $A^2 = b^2 + c^2 - 2bc \cos A.$

$A + B + C = 180°$

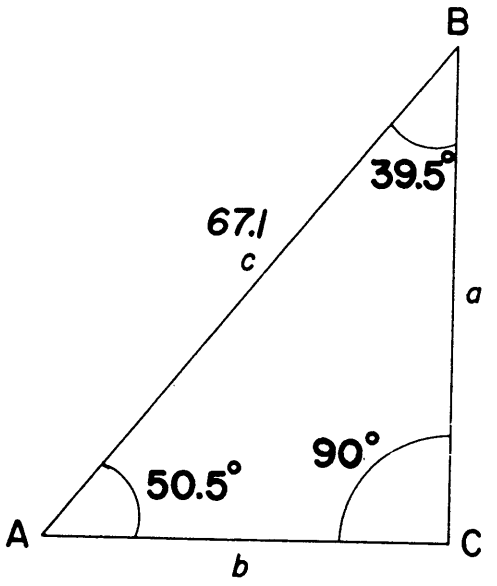
OPERATIONS INVOLVING THE S AND SRT SCALES

Combined operations and proportions by means of the S and SRT scales are accomplished similarly to square roots and reciprocals by means of the B scale and the CI scale. See Mathematics, Vol. I, NavPers 10069. Thus to find 6 sin 30°, opposite 6 on D set index of C, opposite 30° on S read on D, 3.0 = 6 sin 30°. The decimal point is placed after observing on the slide rule that sin 30° is 0.5 and therefore that 6 sin 30° is 6 X 0.5 = 3.0. The legend of the S scale indicates the value of sin 30° is a value between 0.1 and 1.0.

To find 6/ cos 30°, opposite 6 on D scale set 30° of S red, opposite index of C read on D, 6.928 = 6/ cos 30°. The decimal point is placed after observing on the slide rule that the cosine of 30° is approximately 0.86 and therefore 6/ cos 30° is nearly equal to 6/0.86 = 7. Here again the legend 0.1 to 1.0 is S indicates the value of the cosine 30°.

SOLVING THE RIGHT TRIANGLE

To solve the right triangle illustrated in figure A10-2 (note that 90° and 67.1 are opposite),
opposite 671 on D set 90° of S,
opposite 50.5° on S read a = 51.75 on D,
opposite 39.5° on S read b = 42.7 on D.



1.377

Figure A10-2.—Right triangle.

To solve the right triangle illustrated in figure A10-3.
opposite 625 on D set 90° of S,
opposite 524 on D read B = 57° on S,
compute A = 90° - B = 33°,
opposite 33° on S read a = 3.4 on D.

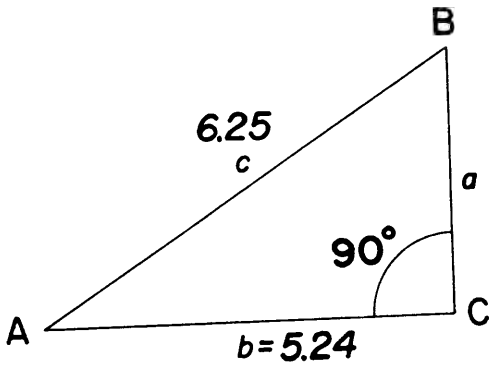
To solve any triangle for which a side and the angle opposite are known,
opposite the known side on D set opposite angle on S,
opposite any known side on D read opposite angle on S,
opposite any known angle on S read opposite side on D.

EXERCISES

Solve the following right triangles for the unknown values of A, B, a, b, and c.

(19) a = 50, A = 65°.
(20) a = 21.2, B = 31.2°.
(21) c = 200, A = 62°.
(22) A = 71°, b = 328.
(23) c = 21.8, A = 47.3°.
(24) b = 36.9, A = 12.35°.

For angles less than 5.73°, use the SRT scale for the sine of the angle.



1.378

Figure A10-3.—Right triangle.

THE T (TANGENT) SCALE

The black numbers on the T scale represent angles from 5.71° to 45°, and the red numbers represent angles from 45° to 84.29°.

When the hairline is set to an angle A on T (black), tan A is at the hairline on C, and hence on scale D when the rule is closed. When the hairline is set to an angle A on T red, tan A is at the hairline on the CI scale.

The black legend indicates 0.1 to 1.0 or 5.71° to 45°, and the red legend indicated 1.0 to 10.0 or 45° to 84.29°

Example:
opposite 30° on T (black), read on C, 0.577 = tan 30°,
opposite 60° on T red, read on CI, 1.732 = tan 60°.

The cotangent of an angle may be found by using the formulas;

$$\cot A = \frac{1}{\tan A}, \text{ or } \cot A = \tan (90° - A).$$

Thus, to express the cotangent as the tangent of an angle, the following example is given.

cot 26° = tan (90° - 26°) = tan 64° and
opposite 64° on T red read on CI, 2.05 = cot 26°, or

$$\cot 26° = \frac{1}{\tan 26°} \text{ and}$$

opposite 26° on T read on CI, 2.05 = cot 26°.

In computing an expression involving the tangent of an angle greater than 45° or any cotangent of an angle, it is advisable before beginning the computation to replace the tangent or cotangent by a tangent of an angle less than 45°. Thus to compute 428 tan 54°/cot 44° first write;

$$\frac{428 \tan 54°}{\cot 44°} = \frac{428 \cot 36°}{\cot 44°} = \frac{428 \tan 44°}{\tan 36°}$$

and then push the hairline to 428 on D, draw 36° of T under the hairline, push the hairline to 44° on T, at the hairline read on D, 568. The decimal point was placed after making the rough approximation of $\frac{400 \times 1}{0.7} = 550+$. The numbers 1 and 0.7 lie within the range of the T scale, 0.1 to 1.0 specified by the legend.

EXERCISES

(25) $\tan x = \frac{4.2}{5.6}$.

(26) $\tan x = \frac{3.9}{33}$.

(27) $\tan x = \frac{296}{428}$.

(28) $\tan x = \frac{529}{343}$.

(29) $\tan x = \frac{39.7}{86.3}$.

(30) $\tan x = \frac{1062}{2405}$.

(31) $\cot x = \frac{4}{5}$.

(32) $\cot x = \frac{16.3}{13.7}$.

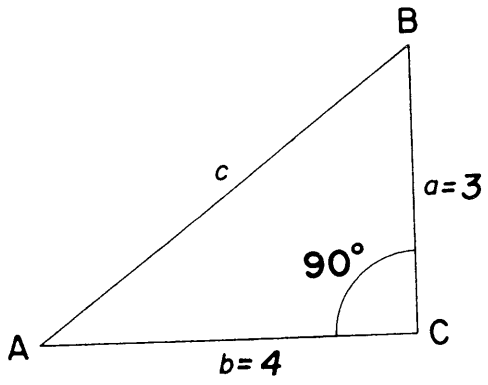
(33) $\cot x = \frac{211}{434}$.

THE LAW OF SINES APPLIED TO RIGHT TRIANGLES WITH TWO LEGS GIVEN

When the two legs of a right triangle are given, first find the smaller acute angle from its tangent and then apply the law of sines to complete the solution.

Example. Solve the triangle illustrated in figure A10-4 in which a = 3 and b = 4.

Solution. From the triangle read $A = \tan \frac{3}{4}$.



1.379

Figure A10-4.—Right triangle with two legs given.

Hence write $\frac{T}{D}:\frac{\tan A}{3}=\frac{1}{4}$ and

opposite 4 on D set index of C,
push hairline to 3 on D,
at hairline read A = 36.88° on T,
at hairline read B = 53.12 on T red. See figure A10-5A.

Now complete the solution by using the method of sines as explained earlier. Since the hairline is set to 3 on D, draw the opposite angle 36.88° of S under the hairline, and opposite 1 (= sin 90°) on S read c = 5 on D. See figure A10-5B.

Rule

To solve a right triangle for which two legs are given, to the larger leg on scale D set the proper index of the slide, push the hairline to the smaller leg on D, at the hairline read smaller acute angle of triangle on T, draw this angle on S under the hairline, and at the index of the slide read the hypotenuse on D.

Example. Solve the triangle illustrated in figure A10-6 in accordance with the above rule.

Solution. Set the right index of C to 734 on D, push hairline to 396 on D,

at hairline read B = 28.4° on T,
draw 28.4° on S under the hairline,
at index of S read c = 833 on D.

Therefore A = 90° - B = 61.6°.

Exercises

Solve the following right triangles for the unknown values of A, B, and c.

(34) a = 13.1, b = 16.9.
(35) a = 22, b = 31.
(36) a = 571, b = 627.
(37) a = 43.9, b = 80.1.
(38) a = 46, b = 43.1.
(39) a = 1034, b = 1678.

For a more detailed discussion on the use of the slide rule, refer to any authoritive slide rule manual such as those published by the Keuffel and Esser Co.

NOTE: ALL ANSWERS TO PROBLEMS SHOULD BE WITHIN 3 PLACES OF THE 3RD SIGNIFICANT FIGURE. ALL ANSWERS LISTED ARE TO TABLE ACCURACY.

	sin	cos
1.	0.5299	.8480
2.	0.8988	.4384
3.	0.0324	.9995
4.	0.0490	.9988
5.	0.7455	.6665
6.	0.9511	.3090
7.	0.0583	.9983
8.	0.8320	.5548
9.	0.0839	.9965
10.	1.0000	0.0000

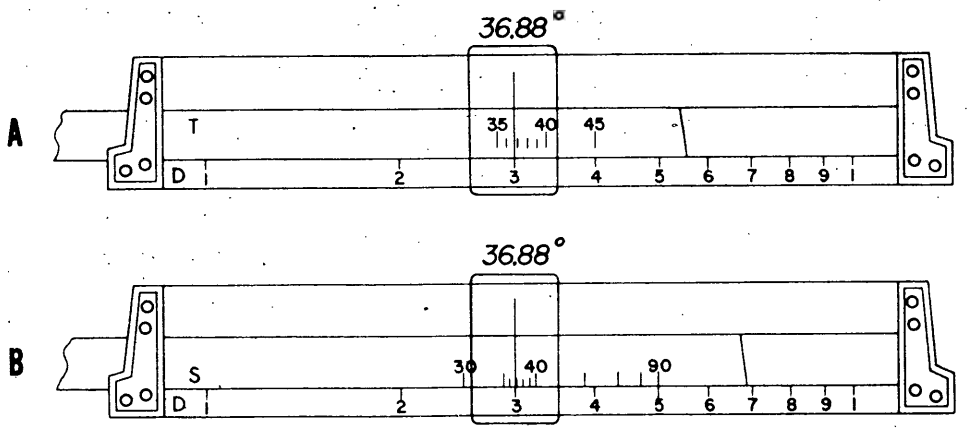


Figure A10-5.—Trigonometric scales of the slide rule. A. T scale. B. S scale.

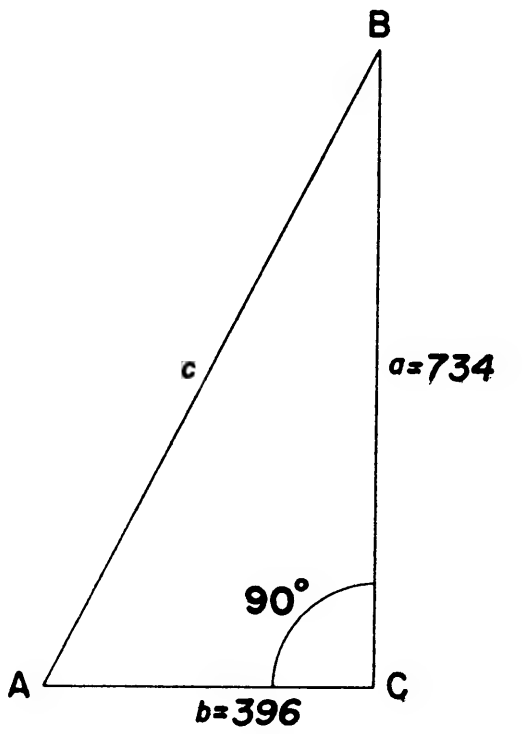


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Figure A10-6.—Right triangle with two legs given.

	sin	cos
11.	0.9979	.0645
12.	0.7071	.7071
	sin x	**cos x**
13.	30°	60°
14.	42.9°	47.1°
15.	29°	61°
16.	5.73°	84.27°
17.	0.916°	89.084°
18.	2.1°	87.9°

19. b = 23.3
c = 55.2
B = 25°

20. b = 12.82
c = 24.8
A = 58.8°

21. a = 176.5
b = 94
B = 28°

22. a = 952
c = 1006
B = 19°

23. a = 16
b = 14.77
B = 42.7°

24. a = 8.08
c = 37.8
B = 77.65°

25. 36.9°

26. 6.74°

27. 34.64°

28. 57.05°

29. 24.7°

30. 23.7°

31. 51.4°

32. 40.25°

33. 64.1°

34. A = 37.6°
B = 52.4°
c = 21.4

35. A = 35.4°
B = 54.6°
c = 38

36. A = 42.35°
B = 47.65°
c = 849

37. A = 26.2°
B = 63.8°
c = 99.4

38. A = 46.9°
B = 43.1°
c = 63

39. A = 31.7°
B = 58.3°
c = 1970

APPENDIX XI

RADIOFREQUENCY CABLE SPECIFICATIONS

AN. TYPE NUMBER	INNER CONDUCTOR	DIELECTRIC MATERIAL	SHIELDING BRAID	PROTECTIVE COVERING	NOMINAL OVER-ALL DIA (in.)	NOMINAL IMPEDANCE (ohms)	NOMINAL CAP. (μμf/ft)	R-M-S MAX OPERATING VOLTAGE (volts)	ATTENUATION IN DECIBELS (APPROX) PER 100 FT				
									50 MC	100 MC	200 MC	500 MC	1000 MC
RG-5/U	16 AWG copper	A	Copper	Vinyl	0.332	52.5	28.5	3000		2.80	4.00	6.00	10.00
RG-6/U	21 AWG copperweld	A	Inner: silver-coated copper. Outer: copper.	Vinyl (noncon-taminating)	0.332	76.0	20.0	2700		2.50	4.00	7.00	10.30
RG-7/U	19 AWG copper	A or B	Copper	Vinyl	0.370	90–105	12.5 14.0 (max)	1000	1.50	1.90	3.20	5.00	7.50
RG-8/U	7/21 AWG copper	A	Copper	Vinyl	0.405	52.0	29.5	4000	1.37	2.10	3.15	5.50	8.50
RG-9/U	7/21 AWG silvered copper	A	Inner: silver-coated copper. Outer: copper.	Vinyl (noncon-taminating)	0.420	51.0	30.0	4000	1.37	2.10	3.15	5.50	8.50
RG-9A/U	7/21 AWG silvered copper	A	Silvered copper	Vinyl (noncon-taminating)	0.420	51.0	30.0	4000	1.37	2.10	3.15	5.50	8.50
RG-10/U	7/21 AWG copper	A	Copper	Vinyl (noncon-taminating) armor	0.475 (max)	52.0	29.5	4000	1.37	2.10	3.15	5.50	8.50
RG-11/U	7/26 AWG tinned copper	A	Copper	Vinyl	0.405	75.0	20.5	4000	1.27	1.90	2.85	5.00	7.70
RG-12/U	7/26 AWG tinned copper	A	Copper	Vinyl (noncon-taminating) armor	0.475	75.0	20.5	4000	1.27	1.90	2.85	5.00	7.70
RG-13/U	7/26 AWG tinned copper	A	Copper	Vinyl	0.420	74.0	20.5	4000	1.27	1.90	2.85	5.00	7.70
RG-14/U	10 AWG copper	A	Copper	Vinyl (noncon-taminating)	0.545	52.0	29.5	5500		1.40	2.00	3.20	5.00
RG-15/U	15 AWG copperweld	A	Copper	Vinyl	0.545	76.0	20.0	5000		1.50	2.10	4.00	6.00
RG-16/U	Copper tube; nom dia, 0.125 in.	A	Copper	Vinyl	0.630	52.0	29.5	6000		1.25	1.90	3.20	5.20
RG-17/U	0.188 copper	A	Copper	Vinyl (noncon-taminating)	0.870	52.0	29.5	11,000	0.550	0.850	1.30	2.45	4.00

Table A11-1.—Radiofrequency Cable Specifications

Table A11-1.—Radiofrequency Cable Specifications

AN. TYPE NUMBER	INNER CONDUCTOR	DIELECTRIC MATERIAL	SHIELDING BRAID	PROTECTIVE COVERING	NOMINAL OVER-ALL DIA (in.)	NOMINAL IMPEDANCE (ohms)	NOMINAL CAP. (μμf/ft)	R-M-S MAX OPERATING VOLTAGE (volts)	ATTENUATION IN DECIBELS (APPROX) PER 100 FT				
									50 MC	100 MC	200 MC	500 MC	1000 MC
RG-18/U	0.188 copper	A	Copper	Vinyl (noncontaminating) armor	0.945 (max)	52.0	29.5	11,000	0.550	0.850	1.30	2.45	4.00
RG-19/U	0.250 copper	A	Copper	Vinyl (noncontaminating)	1.120	52.0	29.5	14,000		0.650	1.15	2.10	3.40
RG-20/U	0.250 copper	A	Copper	Vinyl (noncontaminating) armor	1.195 (max)	52.0	29.5	14,000		0.650	1.15	2.10	3.40
RG-21/U	16 AWG resistance wire	A	Inner: silver-coated copper. Outer: copper.	Vinyl (noncontaminating)	0.332	53.0	29.0	2700		14.00	19.00	30.00	42.00
RG-22/U	2-conductor 7/0.0152 copper	A	Tinned copper (single)	Vinyl	0.405	95.0	16.0	1000	2.50	3.30	4.30		
RG-23/U	2-conductor 7/21 AWG copper	A	Copper (individual inners; common outer)	Vinyl	0.650 x 0.945	125.0	12.0	3000	1.10	1.80	2.60		
RG-25A/U	19/0.0117 tinned copper	E	Tinned copper	Synthetic rubber	0.505	48.0	50.0	8000 (peak)					
RG-26A/U	19/0.0117 tinned copper	E	Tinned copper	Synthetic rubber armor	0.505	48.0	50.0	8000 (peak)					
RG-27/U	19/0.0185 tinned copper	D	Tinned copper	Vinyl armor	0.675 (max)	48.0	50.0	15,000 (peak)					
RG-28/U	19/0.0185 tinned copper	D	Inner: tinned copper. Outer: galvanized steel.	Synthetic rubber	0.805	48.0	50.0	15,000 (peak)					
RG-29/U	20 AWG copper	A	Tinned copper	Polyethylene	0.184	53.5	28.5	1900	2.90	4.00	5.90	10.00	17.00
RG-34/U	7/21 AWG copper	A	Copper	Vinyl	0.625	71.0	21.5	5200	1.20	1.80	2.80		

Table A11-2.—Radiofrequency Cable Specifications—Continued

AN. TYPE NUMBER	INNER CONDUCTOR	DIELECTRIC MATERIAL	SHIELDING BRAID	PROTECTIVE COVERING	NOMINAL OVER-ALL DIA (in.)	NOMINAL IMPEDANCE (ohms)	NOMINAL CAP. (μμf/ft)	R-M-S MAX OPERATING VOLTAGE (volts)	ATTENUATION IN DECIBELS (APPROX) PER 100 FT				
									50 MC	100 MC	200 MC	500 MC	1000 MC
RG-35/U	9 AWG copper	A	Copper	Vinyl (noncontaminating) armor	0.945	71.0	21.5	10,000		0.70	1.20	2.50	4.00
RG-38/U	17 AWG tinned copper	C	Tinned copper	Polyethylene	0.312	52.5	38.0	1000	6.00	9.80	14.00	26.00	44.00
RG-39/U	22 AWG tinned copperweld	C	Tinned copper	Polyethylene	0.312	72.5	28.0	1000	6.00	9.80	14.00	26.00	44.00
RG-40/U	22 AWG tinned copperweld	C	Tinned copper	Synthetic rubber	0.420	72.5	28.0	1000	6.00	9.80	14.00	26.00	44.00
RG-41/U	16/30 AWG tinned copper	C	Tinned copper	Neoprene	0.425	67.5	27.0	3000					
RG-42/U	21 AWG high-resistance wire	A	Silvered copper (2 braids)	Vinyl (noncontaminating)	0.342	78.0	20.0	2700		15.00	22.00	33.00	50.00
RG-54A/U	7/0.0152 copper	A	Tinned copper	Polyethylene	0.250	58.0	26.5	3000		3.00	4.40		
RG-55/U	20 AWG copper	A	Tinned copper	Polyethylene	0.206 (max)	53.5	28.5	1900	2.90	4.00	5.90	10.00	17.00
RG-57/U	2-conductor 7/21 AWG copper	A	Tinned copper (single)	Vinyl	0.625	95.0	17.0	3000	1.80	2.90	4.60		
RG-58/U	20 AWG copper	A	Tinned copper	Vinyl	0.195	53.5	28.5	1900	2.90	4.00	5.90	10.00	17.00
RG-58A/U	20 AWG Class C stranded tinned copper	A	Tinned copper	Vinyl	0.195	52.0	28.5	1900	3.10	5.00	8.00	13.00	21.00
RG-59/U	22AWG copperweld	A	Copper	Vinyl	0.242	73.0	21.0	2300	2.30	4.00	5.50	10.00	14.00
RG-62/U	22 AWG copperweld	A or B	Copper	Vinyl	0.242	93.0	13.5 14.5 (max)	750	2.10	3.10	4.30	7.00	10.00

Table A11-3.—Radiofrequency Cable Specifications—Continued

Table A11-3.—Radiofrequency Cable Specifications—Continued

AN. TYPE NUMBER	INNER CONDUCTOR	DIELECTRIC MATERIAL	SHIELDING BRAID	PROTECTIVE COVERING	NOMINAL OVER-ALL DIA (in.)	NOMINAL IMPEDANCE (ohms)	NOMINAL CAP. (μμf/ft)	R-M-S MAX OPERATING VOLTAGE (volts)	ATTENUATION IN DECIBELS (APPROX) PER 100 FT				
									50 MC	100 MC	200 MC	500 MC	1000 MC
RG-63/U	22 AWG copperweld	A or B	Copper	Vinyl	0.405	125.0	10.0 11.0 (max)	1000	1.30	2.00	2.80	4.40	6.40
RG-64A/U	19/0.0117 tinned copper	E	Tinned copper	Synthetic rubber	0.475	48.0	50.0	8000 (peak)					
RG-65/U	No. 32 Formex F; helix dia, 0.128 in.	A	Copper (single)	Vinyl	0.405	950.0	44.0	1000					
RG-71/U	22 AWG copperweld	A	Inner: plain copper. Outer: tinned copper.	Polyethylene	0.250	93.0	13.5 14.5 (max)	750	2.10	3.10	4.30	7.00	10.00
RG-74/U	10 AWG copper	A	Copper	Vinyl (noncontaminating) armor	0.615	52.0	29.5	5500		1.40	2.00	3.20	5.00

A—Stabilized polyethylene. B—Polymeric resin mixture. C—Synthetic rubber compound.
D—Layer of synthetic rubber dielectric between thin layers of conducting rubber.
E—Inner layer of conducting rubber; center layer of synthetic rubber; outer layer of red insulating synthetic rubber.

Table A11-4.—Radiofrequency Cable Specifications—Continued